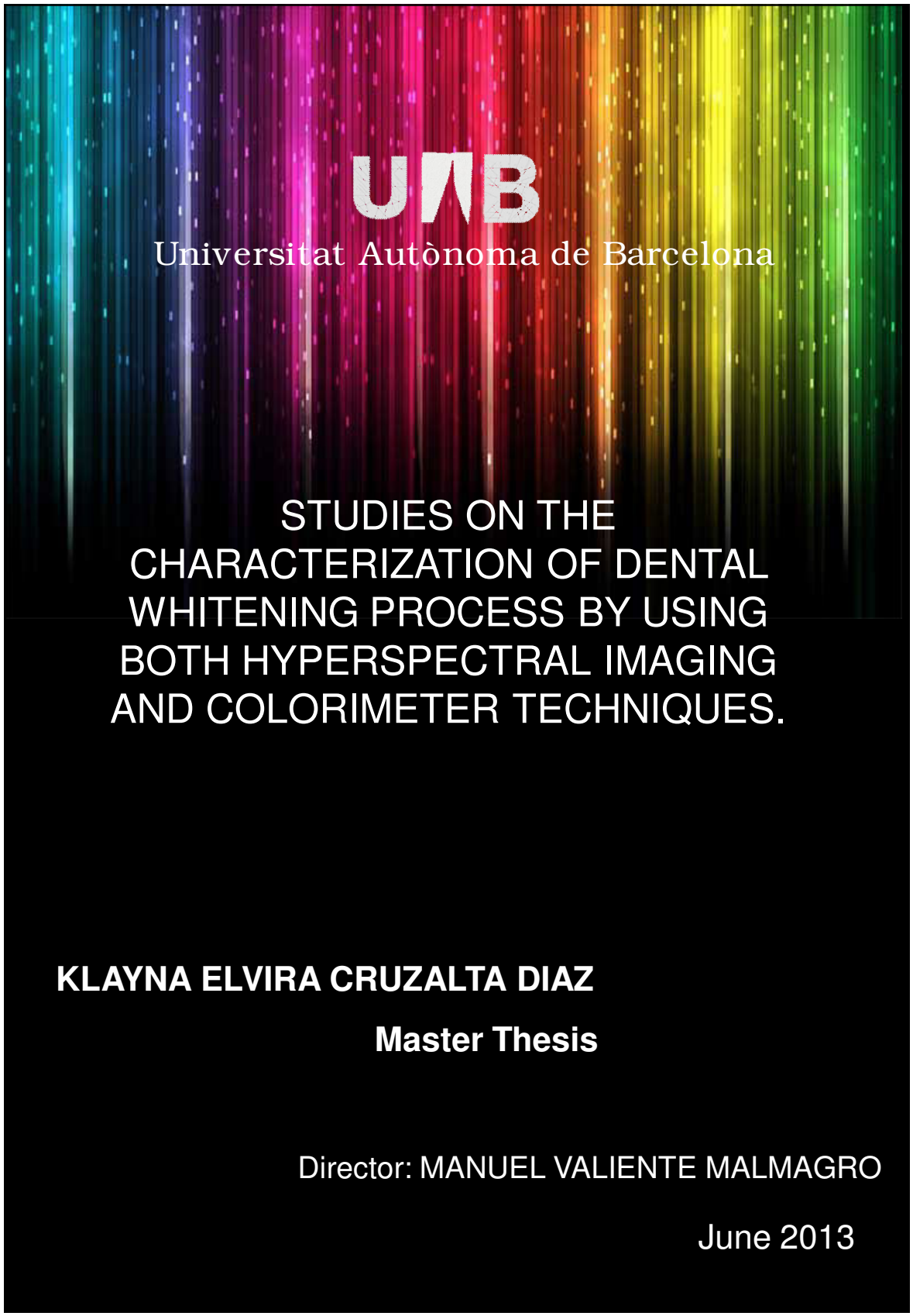

STUDIES ON THE CHARACTERIZATION OF DENTAL WHITENING PROCESS BY USING BOTH HYPERSPECTRAL IMAGING AND COLORIMETER TECHNIQUES.

KLAYNA ELVIRA CRUZALTA DIAZ

Master Thesis

Director: MANUEL VALIENTE MALMAGRO

June 2013

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KLAYNA ELVIRA CRUZALTA DIAZ

Tesis de master

Programa Máster en Experimentación Química

Director: Manuel Valiente Malmagro.

Departamento de Química

Facultad de Ciencias

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SUMMARY

Studies on the characterization of dental whitening process by using both hyperspectral imaging and colorimeter techniques.

A beautiful smile is directly related with white teeth. Nowadays oral care has increased and developed processes for beautiful smiles. Dental bleaching is frequently used in odontology, not just for health care also for aesthetic treatment.

With the possibility of teeth bleaching, now the importance is in, how white the tooth is? Because color is relate to an individual perception. In order to assets teeth correct color identification has been developed many color guides, models, spaces and analytical methods.

Spite all of these useful tools the color interpretation depends on environmental factors, position of the sample in the data acquisition and most importantly the instrument sensitivity. The commons methods have proved to be useful. They are easy to handle, some are portable but they do not have a high sensitivity.

The present work is based on the integration of a new analytical technique for color acquisition. High spectral Image (HSI) is able to performed image analysis with high quality and efficiency. HSI is used in many fields and we used it for color image analysis within the bleaching process.

The main comparison was done with the HSI and the colorimeter through the processes of two different bleaching protocols. The results showed that HSI has higher sensitivity than the colorimeter. During the analysis the dental surface with the HSI we were able to notice surface changes. These changes were analyzed by roughness studies.

INTRODUCTION

Though history society has enforce a standard of beauty, as consequence white teeth reflect health, power, wealth, and beauty, Because of this, bleaching is one of the beauty treatments used more frequently every day. Patients look for professional assistance or in a dangerous move, they do it themselves buying some product from stores risking their health.

As chemistry is necessary to understand the structure, composition and interaction of the tooth under different conditions, in order to provide a very solid background for the innovations in dental care.

Smile is the facial expression that most engages others. With the help of the teeth which provide structural support for the face muscles the mouth also form a frown and other expressions that show up on your face.

TOOTH

Structure.

Teeth are very hard structures in the body. In Figure 1. Vertical section of a molar tooth showing internal structure we can observe the general tooth structure. The tooth has two anatomical parts: the crown and root. The crown of a tooth is the part usually visible in the mouth, The external part is the enamel and inside of it we can find the dentin both of them play a very important part in bleaching process

The root is the part embedded in the jaw. It anchors the tooth in its bony socket and is normally not visible.[1-2.]

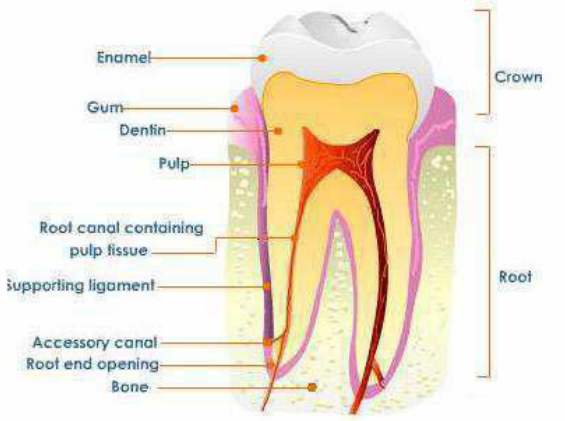


Figure 1. Vertical section of a molar tooth showing internal structure.

Properties.

The principal surface in which this work thesis has been done, is the enamel and dentin, and in Table 1, we can observe the principal characteristic of the two main surface we worked with.

	ENAMEL	DENTIN
FEATURES	The enamel is an extracellular substance, highly mineralized and composed by crystals. It is sensible to acids attacks, covers the dentin and is the visible part of the tooth. It has a thickness of 2.2 – 2.5 mm	Dentin has great tensile strength. Its color is pale yellow and is a bit harder than bone. Dentin provides an elastic basis and the color for enamel. It also provides a chamber and protective barrier for the vital pulp tissues
CHEMICAL PROPERTIES	• 96% minerals (hidroxyapatite crystals, traces of carbonates, nitrates, sodium, magnesium, lead, selenium, vanadium and strontium. • 1% matrix proteins and lipids (glycine, serine, aspartic acid glutamic acid, leucine (20%), proline (1%) • 3% H_2O.	• 50% by volume mineral content (hydroxyapatite crystals rich in carbonates and poor in calcium). • 30% by volume of organic matrix, predominantly collagen type 1. • 20% is a fluid similar to blood plasma, but less well defined.[1]
PHYSICAL PROPERTIES	• Color and translucency • Permeability • Radiopacity • Hardness • Compressive strength • Modulus of elasticity	• the main physical characteristics of dentin are the hardness and elasticity is vascular • Dentin is renewed and deposited lifelong, the older lower velocities of the formation.

Table 1. Principal characteristics from the enamel and dentin[3]

DENTAL DISCOLORATION

The attraction of substances toward the tooth surface is important in the formation of the discolorations. There are different types of interactions such as long-chain interactions. Van der Waals forces, dipole - dipole etc. With this type of interaction is allowed to approach the chromophores to the dental surface and form dental stain.[4]

Therefore, It is necessary to understand that the causes of tooth discoloration are several and multifaceted, they are classified in intrinsic, internalized discoloration and extrinsic, the latter is caused by deposition of external chromophores like food and drinks that contain colored substances that can leave stains with a trend of less pigmented molecules attached to the tooth enamel surface or within the pellicle layer that adheres to the enamel surface.[5]

The reason why we are able to see color change on the teeth is because chromophores acquire coloration according to their ability to absorb, transmit or reflect incident white light. In the electromagnetic spectrum emission, Chromophores are unsaturated molecules and they can be observed in a region of 400 to 700 nm, the visible range of the electromagnetic spectrum.[6]

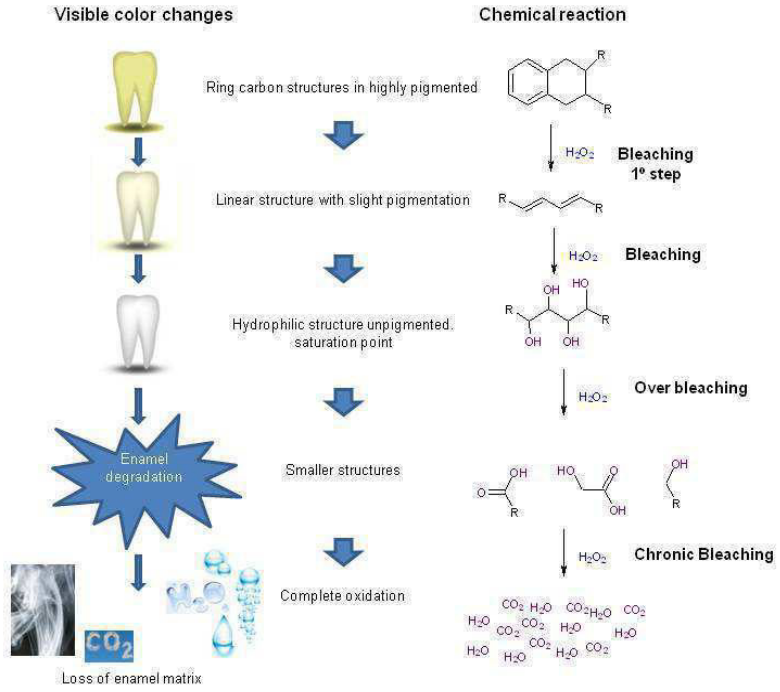
BLEACHING

A whitening dental procedure has been established analysing dental stain composition, It. In order to remove stains or chromophores is necessary to break the double bonds, which are the responsible for giving the color to chromophores, and to carry out this task now days bleaching agents are used by chemical activation techniques. This technique is done through an oxidation - reduction darkened molecules by the release of oxygen to avoid toxicity, super whitening and diseases that come with it.[7]

Bleaching Chemistry

In dental bleaching, hydrogen peroxide is commonly use into huge variety of whitening products because is able to produce a lot of kinds of radical. Hydrogen peroxide diffuses through organic matrix of enamel and dentin. Hydrogen peroxide produce oxygen radicals that have free electrons and are extremely electrophilic and unstable and attack most organic molecules to achieve stability by generating other radicals. These radicals can react with most unsaturated junctions resulting in disruption of conjugation of the electron and a change in the energy absorption of organic molecules in the tooth enamel. Simple molecules are

formed, they reflect less light, creating a successful bleaching action[8] as it is shown in Scheme 1. Bleaching general process.



Scheme 1. Bleaching general process.

Bleaching process occurs when the oxidizing agent reacts with an organic material in the spaces between inorganic salts in the enamel. During the initial clearance, highly pigmented carbon rings are opened and become more subdued color strings.[9,10]

Advanced Oxidation Processes (AOP)

Therefore have been established a non-invasive technologies to carry out a chromophores oxidation, by removing hydrogen atoms or electrophilic addition to the double bonds present. In this point is possible to apply the advanced oxidation processes or technologies (AOP, TAO `s).[11,12] to generated different kinds of radicals.

The TAO's are based on physic - chemical processes able to make profound changes in the chemical structure of organic contaminants, these processes can generate oxidants transitory species that react rapidly for theirs high oxidation potential. In addition oxidants can be produced by different techniques and is highly effective to oxidize non biodegradable organic material using diverse catalytic agents such as sunlight or other energy forms [13,15].

In Table 2. Different Advanced Oxidation Technologies with its principal radical generated reactions. Table 2 is presented the frequently advance oxidation processes used in dental field.

Advanced Oxidation Processes	Principals reactions
Oxidation in alkaline medium	$2\ O_3 + H_2O \rightarrow 2\ HO^{\bullet} + 2\ O_2 + HO_2^{\bullet}$
Ozonization with hydrogen peroxide	$O_3 + H_2O_2 \rightarrow HO^{\bullet} + O_2 + HO_2^{\bullet}$
Fenton processes	$Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + HO^- + HO^{\bullet}$
Electrochemical oxidation	$H_2O \rightarrow HO^{\bullet} + H^+ + e^-$; oxidación $O_2 + 2\ H^+ + 2\ e^- \rightarrow H_2O_2$; reducción
Uv / hydrogen peroxide	$H_2O_2 + h\nu \rightarrow 2\ HO^{\bullet}$
Hyperoxidantes gases (ozone)	$3O_2 + 68.820$ Calories $\rightarrow 2O_3$
Haber Welss Reaction	$H_2O_2\ OH^{\bullet} \rightarrow H_2O_2 + O_2^- + H^+$ $H_2O_2 + O_2^- \rightarrow O_2 + {}^-OH + OH^{\bullet}$

Table 2. Different Advanced Oxidation Technologies with its principal radical generated reactions.

In order to obtain high efficiency in dental bleaching, it is necessary to consider a proper technique to obtain radicals and choose the best oxidizing agent not just for type of radical it can produce, also because those radicals have a combination of a powerful oxidant potential, a good oxidation rate constant of the chromophores and safe reaction conditions to the patient. That is why these processes despite its many applications are poorly understood and applied by countries in Latin America and a little less in the dental field. As example of the possible applications we can mention the remediation and wastewater treatment, disinfection of air, soil, bacteria and viruses

Nowadays there are a huge amount of bleaching products and presentation of them. It is terribly disturbing that these products are not regulated or exclusive for professionals use; otherwise anyone can get them, just go to the store and buy them. The contemporary methods used are those with hydrogen peroxide, They are currently on the market as aqueous solutions, gels with concentration of 30 to 35 % hydrogen peroxide witch activations is done by ultraviolet light, plasma, laser diode as and others.[16]

Side Effects.

Dental world through time have proved to have a very expensive aesthetic procedures, for that reason patients tend to search for products or treatment according to their budget, thus risking the quality and care with which they should be treated in a professional office.

The bleaching process must be monitored carefully by a professional because if it reaches an over oxidation of the chromophores, the protein bonds will break leading to a degradation and loss the tooth's organic matrix. These processe will cause multiples complications to the patient, such as the ones in Table 3.

COMPLICATIONS BY OVEROXIDATION
Reduction of enamel and dentin hardness.
External root resorption,
Changes in dental structure tissues
Reduction in bond strength of resinous materials
Microfiltration of restoration
The injury caused to the complex dentinopulpar
Sensitivity pulp
Gastric irritation and throat if swallowed

Table 3. Common overoxidations complications in bleaching procedures not under professional supervision

As for the side effects of tooth successful whitening has been based on different studies concluded that only two thirds of the patients that use carbamide peroxide may become hypersensitive or gingival irritation. There are some reports of local effects on the oral mucosa and dental tissues during bleaching, namely, pulp sensitivity, cervical resorption, release of selected components of dental restorative materials, and alterations of the enamel surface cause by the different steps the patient have to go through in order to get white teeth. On the other hand bleaching is not a definitive procedure; it will be a color regression after a certain period of time [17-19]

Most of the local effects depended on the technique and concentration of the oxidizing agents. At the present there is not a scientific support to prove that the free radicals produced during advanced oxidation processes used in tooth whitening could cause systemic damage, produce carcinogenic or mutagenic molecules. However, some studies reports adverse toxic or abuse and inappropriate application of bleaching agents. [19 – 22]

Theory of Pain.

Although It is not clear why dental bleaching could cause hypersensitivity for certain patients?. There are several opinions and theories on this topic. Some of them explain the hypersensitivity as consequence of carbamide peroxide sub products trespassing through enamel into the dentine and pulp causing dehydration by the acidity of the gels.

On the other side, there is a general agreement that hypersensitivity during teeth whitening is due to unfavorable osmotic gradient between the bleaching gels with the plasmas and dentinal fluids explained by the Brännström hypersensitivity theory. This theory consider the osmotic pressure differences between the bleaching agent (4900 mOsm/kg) and dentinal fluid (290 mOsm/kg), is negative, reinforces the Brännström theory.

Nowadays there is a very controversial theory about the dental sensitivity (DS) and bleaching sensitivity (BS) that is activated by thermal nociceptor which is a sensory receptor that responds to potentially damaging stimuli by sending nerve signal to the brain. This process called nociception, usually cause the perceptions of pain.[23]

When there is dentin stimulation under any circumstances, results in dental tube`s displacement fluid changes. These changes trigger deeper nerves endings of the tooth causing pain[24]

The hypothesis tells that there is direct nerve activity activation thru the intradentinal way TRPA1, its chemosensitive ion channel properties are activated by oxidants including H_2O_2. The TRP (Transient Receptors Potential Cation Channel) are a group of more than 40 proteins which are also ionic channels, divided in several categories with specific functions, . One of TRP categories is a group of 6 proteins activated by temperature.[25]

The TRPA1 is activated in lower temperature ranges of < 17ºC and < 6 pH. At this condition the ion Ca^{++} is removed and the channel get open to free material transit. Being this the mechanism of bleaching sensitive pain. If this theory is correct, a treatment to reduce dental hyperesthesia could be potassium salts.[26,27.]

As we have been mentioning there are several problem in bleaching procedure, mostly caused by the patient and by the lack of knowledge, some of the problems are due to the chemical properties of some whitening products, the bleaching procedure by itself and not less important by the color measurements techniques, and color appreciation.

In odontology exists several problems on bleaching process, since most of them require repeated applications of the bleaching products, which leads to a wrong use of the products by the patient. Regarding the color measurement is subject to the interpretation of the different dental shade guides that currently exist and the analytical methods for data acquisition providing results with a very low repeatability due to the external light and the interpretation of results.

COLOR EVALUATION

In bleaching world everything is about the color for that reason is necessary to say: Color is the visual perceptual and sensation property corresponding in humans, produced by the effect of light waves striking the retina of the eye producing a stimulus call color. The color of something depends mainly on which wavelengths of light it emits, reflects, or transmits, the sample and by the observer who describes it.

Since color was described as a wavelength in the range of visible light (400-700 nm) of the electromagnetic spectrum for the first time in 1665 by Isaac Newton. Each wavelength range has a different color. The human eye is able to distinguish the difference between two different colors with no problem. However, when it comes to making a difference in the same wavelength range of color, the human eye has many limitations. Science and the analytical techniques allow us to have an accurate assessment of color. [28, 29]

CIE LAB Color space.

Since color is defined as a spectral distribution of light at a certain wavelength. This distribution presents three perceptual attributes:

1. Tint corresponds to the wavelength of the dominant color;
2. Saturation refers to the color purity determined by the hue;
3. Brightness is intensity associated with the light that is reflected.

To get a color quantization from these perceptual attributes or stimulus, was created a model of color. This is an abstract mathematical model describing how the color is presented by numbers in a plane X, Y, Z.

In order for the observer to understand these calculations, it was created a color space which is used for the human being to know how color can be seen in a graphical representation. Using the formulas in Equation 1 is reached the color space known as CIELAB. [30]

$$L^* = 116 f\left(\frac{Y}{Y_0}\right) - 16$$
$$a^* = 500\left[f\left(\frac{X}{X_0}\right) - f\left(\frac{Y}{Y_0}\right)\right]$$
$$b^* = 200\left[f\left(\frac{Y}{Y_0}\right) - f\left(\frac{Z}{Z_0}\right)\right]$$

Equation 1. Formulas to convert triestimulus values Y ,X and Z to CIELAB

In odontology one of the most used methods for analyzed color is CIELAB. The CIE L * a * b * (CIELAB) color model is commonly used to describe all the colors that the human eye can perceive and It is independent of acquire instruments. It was developed specifically for This purpose by the Commission Internationale d'Eclairage (International Commission on Illumination) The International Commission on Illumination is the international authority on light, illumination, color, and color spaces. This commision was established in 1913 as a successor to the Commission Internationale de Photométrie and today It based is in Vienna, Austria. [31]

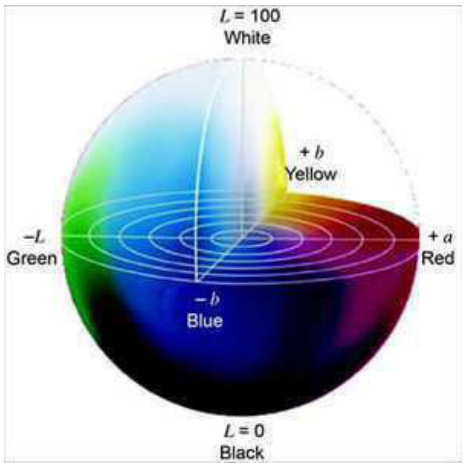


Figure 2. CIELAB space graphical representation.

CIELAB is a platform that provides a standard uniform color scale able to use in many colors analytical instruments. In a uniform color scale the difference between points plotted in the color space correspond to visual difference between the colors plotted. THIS space is organized in a cube form; L* axis runs to top to bottom, the maximum number is 100 and represents a perfect reflecting diffuser. The minimum for L* is zero and represent black. The a* and b* axes have not a specific limits values. Positive a* is red, negative a* is green. Positive b* is yellow and negative is blue.[28, 29] How is shown in Figure 2.

TECHNIQUES FOR COLOR MEASUREMENT.

Currently the color measurement techniques used try to solve one of the biggest problems faced by dentists, A color measure that is equal to any observer and be able to have a repeatability regardless of external factors to the samples.

Colorimeter.

One of most widely used analytical techniques is the colorimetry. Colorimeters permit particular, complete measurement of color in a wide range of environments. They help in creation of color and also permit the special properties of color to be used in settings where human watching is not possible or too subjective. The essential function of a colorimeter is to decide what quality of color is given out from an object. This color can result either from direct luminance by object, or by reflection of other light hitting the object.[32]

The colorimeter measures the color in terms of three perceptual attributes described above. (tristimulus coordinates)

Colorimeter characteristics are:

1. Measurement of color, in the form of three variables, L, a, b, most used the CIELab color space
2. Perform a color, establishing tolerance.
3. It is an objective instrument to determine a certain color.

A colorimeter does not measure density, dot area, grayness, tonal deviation.

Uses:

- Control color printed materials (packaging, packaging, ...)
- Formulation of inks.
- Control of color in a huge variety of materials.
- Tiles and ceramics, ...

Cielab color model was designed to be used independently of the technique. In odontology, normally the colorimetry and photometry are the techniques used. However, we have seen that it is possible to make an analysis of color images with the model cielab. The optical

technic and electron microscopes (SEM, TEM) do not allow us to obtain a true color image of the sample.

Currently there is a mapping technique which allows image analysis of the sample, and which is used in many fields. This technique is High Spectral Image (HSI).

High Spectral Image HSI

The HSI is an analytical instrument able to perform an image analysis. HSI combines the power of digital imaging and spectroscopy. For each pixel in an image, the hyperspectral camera acquires the light intensity (radiance) for a large number (typically a few tens to several hundred) of contiguous spectral bands. Every pixel in the image thus contains a continuous spectrum (in radiance or reflectance) and can be used to characterize surfaces with great precision and detail.

HSI obviously provide much more detailed information about samples. hyperspectral imaging leads to a vastly improved ability of color assessment. In HSI; Hyperspectral refers generally to the number of bands into which spectra can be divided. The general ranking in the spectra is 500 a 1100 nm, but in a few cases also the visible range. [33]

Other factors that may come to be considered in the whitening process is the change of the tooth surface, either by the complications that can be caused in the process or the color, as some studies suggest that the lower roughness greater the effect of the bleaching agent.

Tridimensional profilometer dual technology

It is an optical measurement technology which allows contactless data acquisition at high resolution characterizing different types of surfaces and is suitable for quick obtaining a geometric evaluation noninvasively surfaces and micro and nano scales.

Parameter to consider in the surface measurements are varied, one of them is the roughness defined as a set of microscopic irregularities as a result of natural or handling and manufacturing processes.

In order to understand easily which kind of values this type of microscope provides the main measuring characteristics are as follows.

Roughness Height: It is the height of the irregularities with respect to a reference line. It is measured in millimeters or microns or micro inches. It is also known as the height of unevenness.

Roughness Width: The roughness width is the distance parallel to the nominal surface between successive peaks or ridges which constitute the predominate pattern of the roughness. It is measured in millimeters.

Waviness: This refers to the irregularities which are outside the roughness width cut off values. Waviness is the widely spaced component of the surface texture. This may be the result of workpiece or tool deflection during machining, vibrations or tool runout.[34]

Figure 3

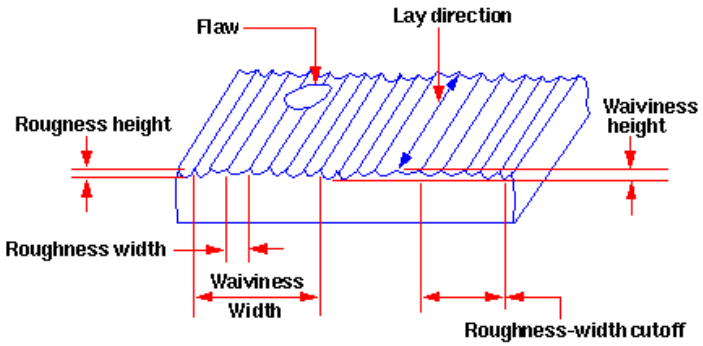


Figure 3. Surfease characteristics

OBJECTIVES

GENERAL OBJECTIVE

This thesis and its research is based on the characterization of color in the bleaching process of dental tissues, using two different analytical techniques. As well as the impact on the tooth surface by the whitening process.

Specific Objectives.

1. Review and comparison of two protocols of dental whitening.

2. Integration of a new analytical technique, the HSI for the color characterization to the world of odontology.

3. Comparison of analytical techniques for color measurement, HSI and colorimeter.

4. Roughness analysis stages of bleaching protocols.

METHODOLOGY

Since the mouth anatomy perfectly describes that every tooth is different in composition, used, and morphology. It has been decided as target sample the incisors because they received in a more direct way the chromophores attack, for this reason we took the analysis of each sample independent.

RESERCH PLAN

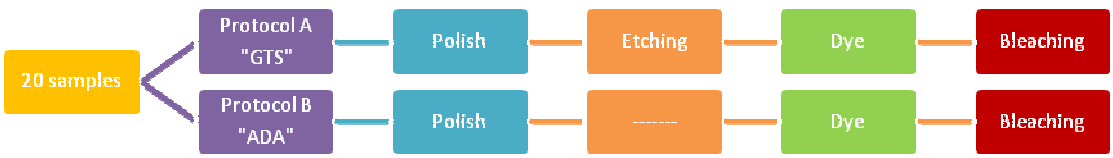
For the analysis of color in dental samples it followed the steps below.

1. Dental Samples were prepared to undertake different stages and treatments.
2. It will analyzed and compare two dental protocols at different stages of the process.
3. The analysis will be done with two analytical techniques, the colorimeter and HIS.
4. The data obtained will receive a statistical treatment and evaluate the results.

SAMPLES

Dental samples that we worked with are from cattle, cow specifically[28]. Since the tooth must be exposed to different treatments is necessary to immobilize them into a cold monomer base auto polymerizing and polymer denture powder that would create a basis that does not react to the different treatments and allows us to handle dental samples more effectively.

The teeth are exposed to the outside labial, so it had been prepared 20 dental samples to follow the two protocols as it is shown in Scheme 2



Scheme 2. Flowchart experiment with different protocols

The protocols used in these experiments correspond to:

- The American Dental Association (ADA), Laboratory Testing Methods.[38]
- Previous thesis work in the GTS Group. [39]

Polish: Samples are polished with a sandpaper P-200, P-600, P-1500 steadily to obtain a smooth surface without exposing the dentin.

Etching: To facilitate staining, etching was performed with a slight exposure in acid medium of 60 sec. HCl (0.12 M), 30 sec. $NaCO_3$ (saturated solution), 60 sec. HCl (12 M) and finally wash with a MilliQ water.

Dye: A solution of dye is changed daily for a period of one week and the samples were immersed in the solution until the solution reached a temperature of 37ºC.

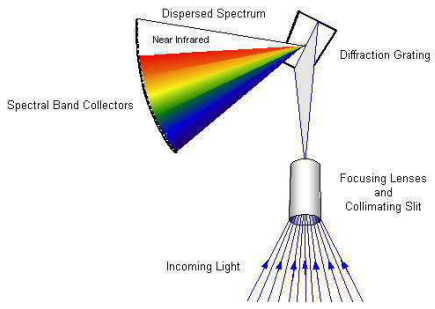
**Grup A*: boil 400ml H_2O with 5 commercial tea bags. 1.35 gr soluble coffee, 1 gr mucin.[30]

**Grup B*: boil 250 ml commercial red wine with 5 commercial tea bags, 9 gr soluble coffee and 6.66 gr mucin.[29]

Bleaching: Was chosen Vivastyle commercial bleach with a concentration of 16% carbamide peroxide, following manufacturer instructions will bleaching period was 2 hr in total.

RESERCH INSTRUMENTS

HSI High Spectral Image



This analytical instrument is able to acquired different kinds of information, wavelengths spectrum in the Near Infrared NIR or Visible range, and a reconstructed images that with special software is available for color analysis being our goal.

Figure 9. A very simplified diagrame of the HSI sensor.

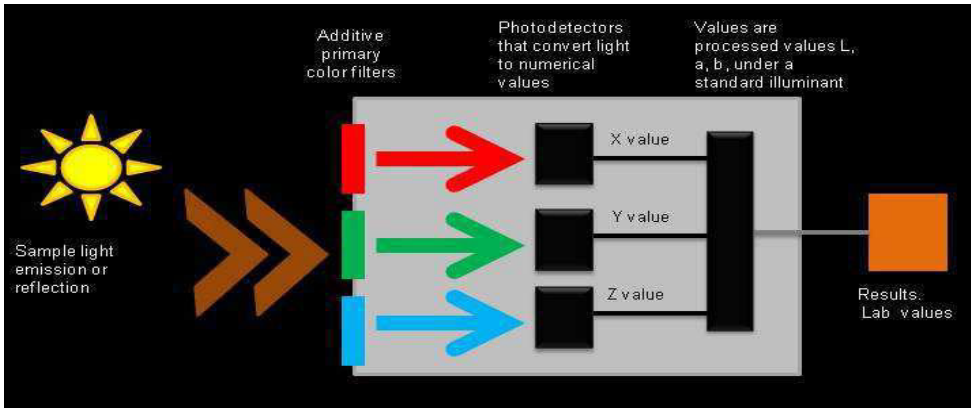
HSI refers generally to the number of bands into which spectra are divided, also is series of images of an object are acquired at many different wavelengths so that the complete spectrum of each pixel is available, which is represented as an image cube, hyperspectral imaging enables fast and quantitative image analysis. The key component for hyperspectral imaging (**HSI**) is the HSI sensor. The HSI sensor receives light that is reflected from below and converts it to electrical signals. like in *Figure 9.*

Hyperspectral imaging has been employed in various scientific disciplines to provide valuable data for fields such as astronomy [40, 41.] earth science and remote sensing [42,45], and computer vision [35].

Colorimeter

Colorimeter is a light-sensitive instrument that measures how much color is absorbed by an object or substance. It determines color based on the red, blue, and green components of light absorbed by the object or sample, much as the human eye does. When light passes through a medium, part of the light is absorbed, and as a result, there is a decrease in how much of the light reflected by the medium. Colorimeters measure tristimulus values more directly than spectrophotometers and function based on color filters. So colorimeters not provide spectral reflectance data. [46, 47]

The colorimeter used in this thesis work is a Minolta CR 300 its technical specifications are in annex 1. In the following Scheme 33 is the general scheme operation of the colorimeter.



Scheme 3 Colorimeter general functioning.

Tridimensional profilometer dual technology

Figure 10. Tridimensional profilometer dual microscope.

It is an optical measurement technology which characterizing different types of surfaces.

The measurement is given by a series of acquisition at a specific point of the sample at different planes passing a focal level. All information that is out of focus is eliminated. Therefore three-dimensional images are obtained with high quality and resolution an without contact of the samples. [48, 49] Like in *Figure 10*

The analysis of tooth surfaces was performed by areas which leads us to obtain the following roughness parameters table 4.

Sa	**Roughness Average**	**[nm]**
Sq	Root Mean Square (RMS)	[nm]
Sp	Max Peak Height	[nm]
Sv	Max Valley Depth	[nm]
Sz	Peak-Peak	[nm]

Table 4. Surface parameters.

DATA PROCESSING

Since the main objective of this study is the color, the values obtained with the two analytical techniques used are from the CIELAB color space. To be able to process the color evaluation, we recognized that data is express in L* a* b* values and as the International Commission on Illumination establishes L* axis represent lightness, positive a* is red, negative a* is green. Positive b* is yellow and negative is blue. [23]

To measure the color in the Colorimeter is not needed more than place the sample below the beam and color values (L, a, b) will appear directly, the range of measurement is 3 mm and is given by the equipment specifications. For the nature of the target samples, the sensibility and limitations of the technique, we call these values as global color (GC). The trials were carried out in the GTS research group in the analytic chemistry department, faculty of Science and Biosciences at the Autonomous University of Barcelona,UAB.

However, for the measurement of HSI was necessary to be performed at the Laboratory for the characterization of particulate materials of Sapienza University of Rome, Italy, Faculty of Engineering. Where the principal data were obtained in the visible spectral range of the HIS, following the equipment specifications. Annex 2.

To get the color values It was necessary to make a pre-selected image reconstructed areas though a special software call Spectral Scanner and an image management tool call Golden Ratio; because by itself, the equipment is able to give just the image in pixels. *Figure 11* Since the equipment gave us the opportunity to select the areas of interest, we decided to divide the tooth in zones; central and peripheral (CZ, PZ) in order to choose the rois in this area and have a suitable identification between them like in the *Figure 12*12.

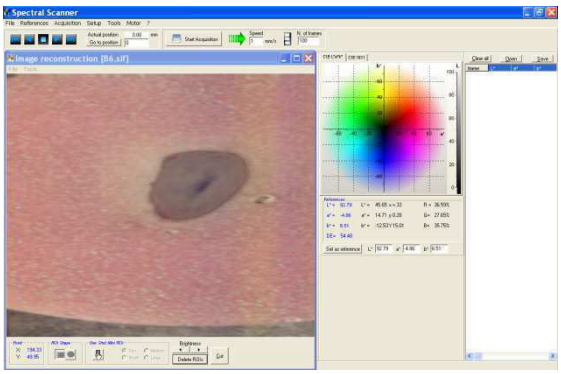


Figure 11 Reconstructed image of the HIS in the Spectral Scanner Software.

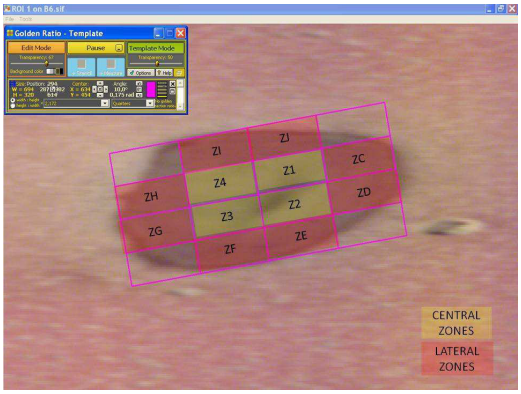


Figure 12 Divisions of the reconstructed image in areas using Golden Ratio Software.

Once the zones were divided was time to select the rois, we chosen ten rois per zone, a total of 120 rois per tooth as it shown in *Figure 13*

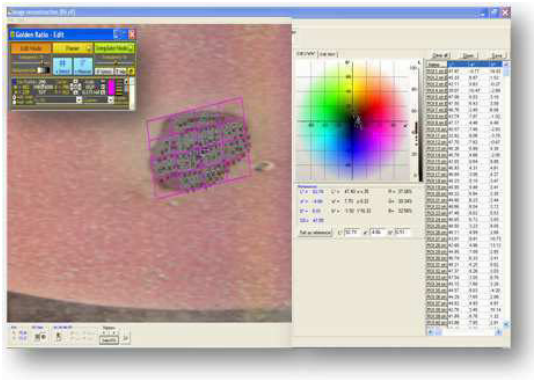


Figure 13 Selection of Rois areas and obtaining color values

A measurement values must be submitted to a statistical treatment to prevent and highlight the potential outlayers. Using Grubss test can make outlayer detection with different levels of trust.

This test detects outliers from normal distributions. The tested data are the minimum and maximum values. The result is a probability that indicates that the data belongs to the core population. We decided to use a 95% confidence, the *Equation 1 Grubbs test for outliers.* that helps us this calculus is the following.

$$T = \left| \frac{X_1 - \overline{X}}{S} \right|$$

Equation 1 Grubbs test for outliers.

$X_1 = Suspicious\ value$

$\overline{X} = Mean$

$S = Standar\ desviation$

For total color calculations difference, was done for each step and according to the Commission Internationale d'Eclairage is expressed as fallow in *Equation 2* and *Equation 3*

$$\Delta a^2 = (\bar{x}_a^2)$$
$$\Delta b^2 = (\bar{x}_b^2)$$
$$\Delta L^2 = (\bar{x}_l^2)$$

$\overline{x} = Mean$

Equation 2 Tristimulus color values formulas

$$\Delta E = \sqrt{\Delta a^2 + \Delta b^2 + \Delta L^2}$$

Equation 3 Total color formula

For getting the percentage of bleaching was calculated with this Equation 4.

$$\%\ Bleaching = \frac{\Delta E_f - \Delta E_0}{\Delta E_0} * 100$$

Equation 4 Percentages of total bleaching

$\Delta E_f = Bleaching\ value$

$\Delta E_o = Dye\ value$

RESULTS

The present study results have been expressed in terms of CIELAB color space. L* a* b* values for the two analytical techniques applied. As we already describe in methodology the data acquisitions and statistical treatment values can be observed in Annex 4.

The principal aim of this study is the characterization of dental bleaching process by two different whitening protocols and applying two different analytical techniques. In order to accomplish this goal:

1. Concerning analytical techniques, Hyper-Spectral Image (HSI) and conventional reflexing colorimeter were employed

2. With respect to protocols and steps involves in the bleaching process, ADA and GTS protocols were applied (as described in Methodology).

3. Dental surface rugosity was determined by separate experiment to correlate the obtained results on possible changes in the superficial structure of the tooth.

In methodology we describe how HSI let us select the areas against the limitation of the colorimeter, the data treatment have been as follow.

ANALYSIS BY ZONES

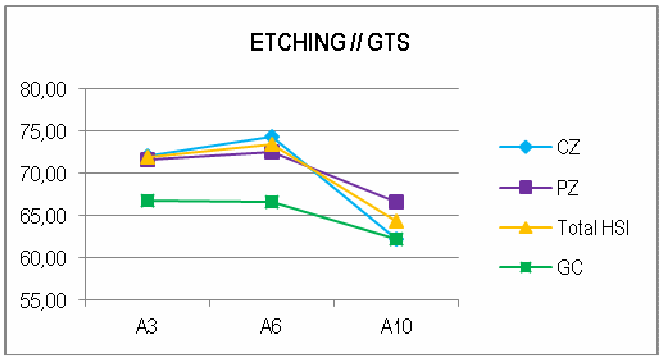
Protocol GTS

Etching

The etching process was done because since it was applied for the first time in 1955 in dental restorations, it was observed that the surface of the teeth was cleaner and more willing to accept any kind of restorations. This condition is due to the dentin pore exposed and open in acid condition, a 10 micrometer layer of the enamel is destroyed. The effects of acid-etching on enamel can vary. Important variables include the application time of the etchant, the type of etchant used, and the individual characteristics of the target enamelIn this etching process and according to literature,[50.51] 3 patterns can be formed having different surface morphology. Being type 1 and type 2 the most favorable patterns, the

explanation for these different patterns is attributed to different crystal orientation in the enamel.

Concerning the obtained color data, the graphic bellow represents the central zones (cz), peripheral zones (pz), average of the HSI and the colorimeter measure (gc) after the etching process. We can observe a similar trend between HSI and colorimeter data but with different values, being HSI higher, indicating a higher sensitivity of the HSI measurements.

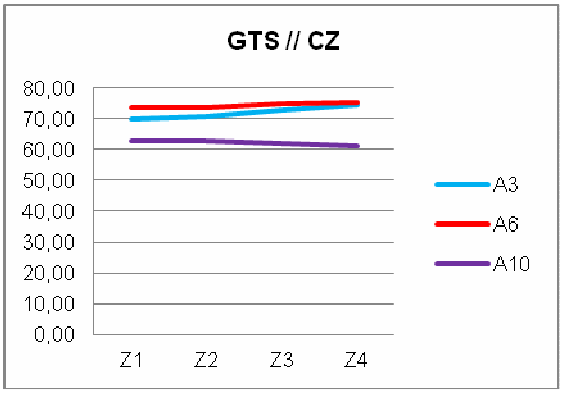


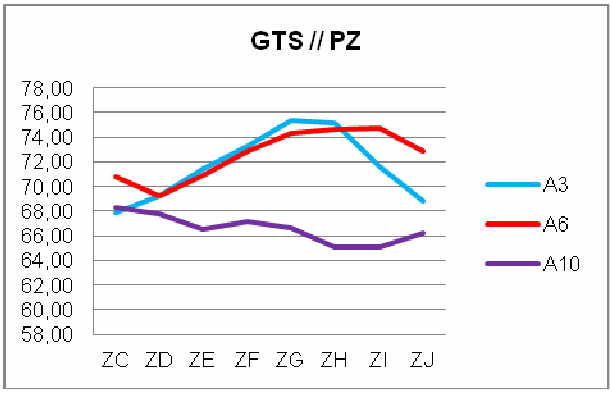
Etching	ΔE			
GTS	CZ	PZ	Total HSI	GC
A3	72.07	71.62	71.84	66.82
A6	74.30	72.56	73.43	66.65
A10	62.15	66.61	64.38	62.29

Chart 1. Total color from HSI and Colorimeter in Etching GTS Protocol

Since the observation area with colorimeter is wide, the measured signal may include the polymer in which the target tooth is placed That is why the precision of the acquisition of the HSI is a determinant factor when comparing the results with the global measure made by the colorimeter.

On the contrary, HSI can guarantee almost 100% of total surface measure, so we are able to identify the areas of interest in the target samples. In the following graphics a significant tendency between the zones is observed. The highest average color values for all samples can be observed in zones 4 and 3 within the central zones For peripheral parts **G** and **H** zones are considered color accumulators. (see in Chart 2.)





ETCHING	CENTRAL ZONES ΔE			
GTS	Z1	Z2	Z3	Z4
A3	69.94	70.92	72.97	74.45
A6	73.74	73.52	74.80	75.13
A10	62.68	62.82	62.04	61.06

ETCHING	PERIPHERAL ZONES ΔE							
GTS	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
A3	67.91	69.26	71.45	73.31	75.37	75.13	71.67	68.84
A6	70.84	69.25	70.87	72.87	74.34	74.67	74.72	72.91
A10	68.35	67.80	66.53	67.12	66.69	65.09	65.08	66.23

Chart 2. Zones color values from HSI in Etching GTS Protocol

On the other hand, considering the tooth from gum to external cervices, two zones are depicted, being the closer to gum the most color accumulator.

This color concentration behavior in etching can be attributed to the type of etching patterns caused by the orientations of the enamel crystals in acids conditions, the loss of hydroxyapatite crystals at the surface, ensured erosion process, leading to a greater exposure of dentin that produces a higher light absorption.

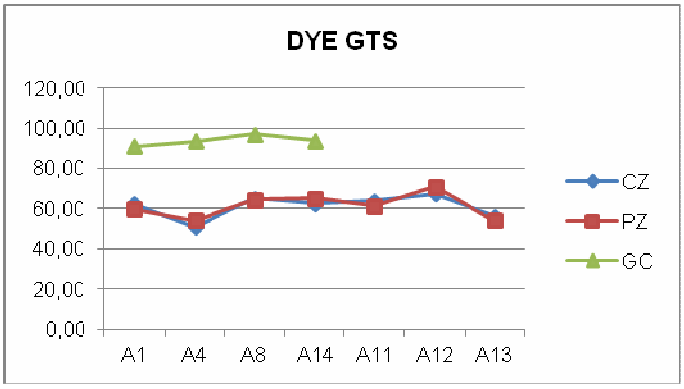
Since incisors were used for the study, its morphology indicates that there is a greater dentin concentration from the center cervix until the gum cervix area, for that reason there is a greater change in color, as the enamel is given by hydroxyapatite crystals and others translucent minerals, the responsible for dental color is the dentin.[52]

Primary function of these analytical techniques is given by the power of the substance to reflect the light, the mineral crystal`s enamel play a transcendent role in the color value. The hydroxyapatite crystals are oriented at a right angles to the dentin surface. In cervix and central parts of the crown these crystals are horizontal. The prisms near the incisal edge gradually shift toward increasingly oblique direction until the edge region are almost vertical.[53,54.] We assume that color detection by different analytical techniques is conditional to both the orientation of the crystals enamel in the tooth, the environmental light and the place and roughness of the point where the measurement is taken.

Dye

This step of the process is vital, because it is where the chromophores were adsorbed on the tooth surface, as a result it will be a critical change in the tooth color. As we already described in methodology for this protocol we worked with the daily human intake of substances.

The comparison between analytical techniques shows similar values in the HSI measured zones and a disparity with the values of the colorimeter, being the former much higher coloured. These differences are attributed to the higher sensitivity of the HSI colour. A possible contribution of the support resin can be the factor on the high observed disparity.

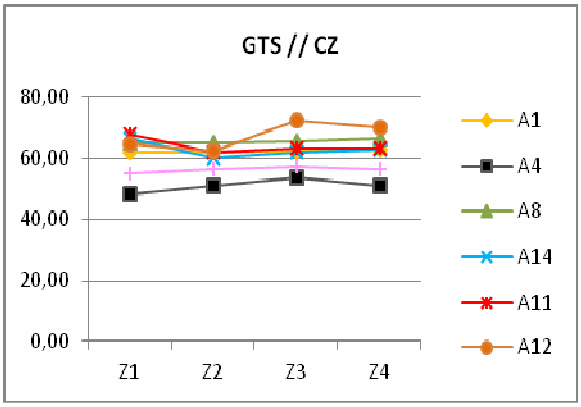


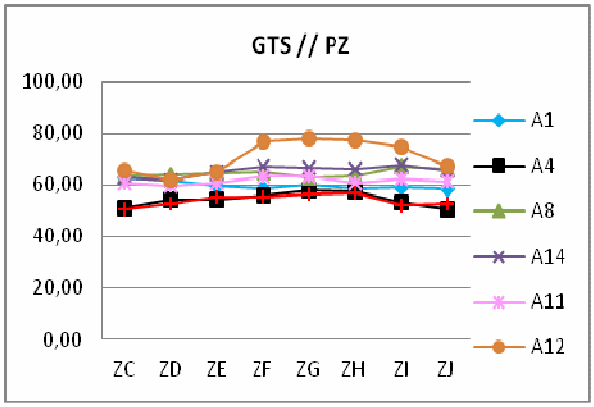
DYE	ΔE AVERAGES		
GTS	CZ	PZ	GC
A1	62.25	59.94	90.99
A4	50.87	54.27	93.48
A8	65.40	64.47	97.05
A14	62.69	65.34	93.73
A11	63.98	61.44	
A12	67.40	70.92	
A13	56.28	54.04	

Chart 3.Total color values from HSI and colorimeter in Dye of GTS Protocol

As for the HSI average values obtained, it shows a clear uniformity of dental staining. Showing an expected decrease of the measured signal in the staining process. Spite of this uniformity, we were able to found small differences between zones. The highest average color values for all samples are located 3 and 4 in the central zones and G and F for the peripheral. As shown in Chart 4

Once again the results indicates a highest color concentration in the gum cervix area of the tooth that is due to the higher adsorption properties of this surface.





DYE	ΔE CZ			
GTS	Z1	Z2	Z3	Z4
A1	61.92	62.02	62.20	62.88
A4	48.07	51.12	53.58	50.72
A8	64.98	64.82	65.57	66.23
A14	66.27	60.03	61.65	62.81
A11	67.66	61.66	63.43	63.16
A12	64.54	62.47	72.52	70.07
A13	55.16	56.18	57.28	56.51

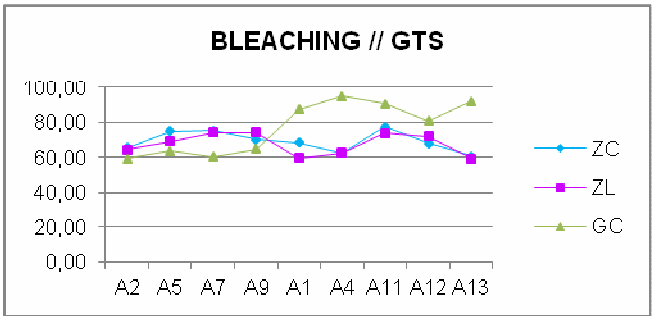
DYE	ΔE PZ							
GTS	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
A1	63.02	62.01	59.49	58.77	60.24	58.29	59.17	58.52
A4	50.94	54.01	54.09	55.61	58.16	57.71	53.15	50.45
A8	63.67	63.70	64.27	64.86	62.91	63.38	66.97	66.00
A14	62.94	61.53	65.18	67.27	66.44	66.20	67.69	65.45
A11	60.66	59.74	60.91	63.16	63.17	60.58	62.14	61.17
A12	65.61	61.88	65.14	76.74	78.07	77.68	74.99	67.26
A13	50.67	52.51	55.43	55.53	56.65	56.87	52.08	52.56

Chart 4. Color zones values from HSI in Dye of GTS Protocol

Bleaching

Decrease of color after bleaching treatment has been followed for the two different protocols, ADA and GTS using HSI and conventional colorimeter.

Thus, when reviewing the results of Chart 5 of the HSI in the whitening process and the colorimeter method we clearly see that we continue to find a correlation between the diverse values of the HSI, however in colorimeter, those differences are not observed. The lower sensitivity of the colorimeter and in particular its wider observation zone can be the responsible of such homogeneity.



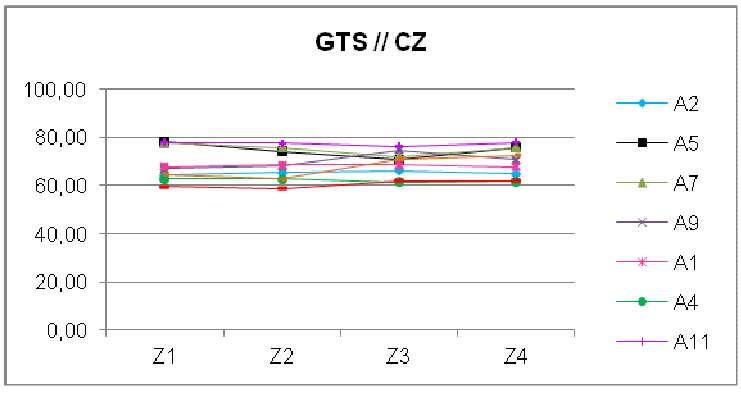
BLEACHING	ΔE		
	ZC	ZL	GC
A2	65.19	64.14	59.175
A5	74.76	68.94	63.702
A7	75.34	74.22	60.412
A9	70.20	74.12	64.672
A1	68.20	59.52	87.245
A4	62.29	62.49	94.917
A11	77.45	73.70	90.406
A12	67.78	71.75	80.641
A13	60.55	59.34	91.868

Chart 5.Total color values from HSI and colorimeter in Bleaching GTS Protocol

In a comparison of the values of staining and whitening, a decrease in the color concentration which indicates that the bleaching reaction was carried out. Will be discuss it below.

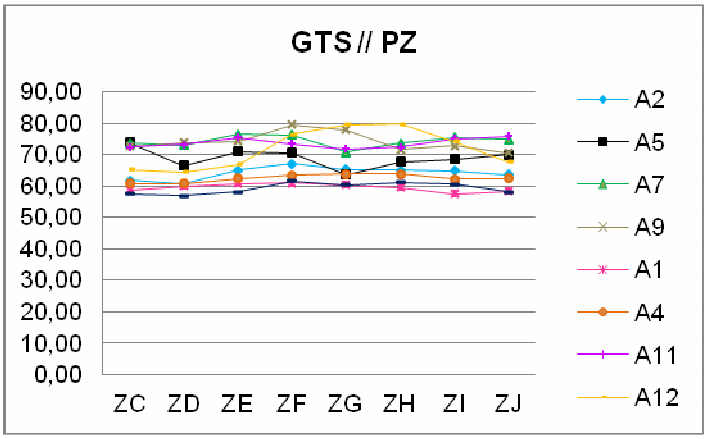
The bleaching values obtained by HSI are being correlated in two main zones, central and peripheral; it is essential to highlight the differences between them.

In the following graphics a significant tendency between the zones is observed. The highest average color values for all samples are in zone **4** and **1** at the central zones (Chart 6) and F and E for the peripheral (chart 7)



BLEACHING	*ΔE CZ*			
GTS	Z1	*Z2*	Z3	Z4
A2	64.31	65.47	66.19	64.79
A5	78.25	74.29	70.71	75.80
A7	77.74	75.83	71.99	75.80
A9	67.06	68.21	74.73	70.79
A1	67.73	68.58	68.55	67.95
A4	62.90	62.90	61.51	61.84
A11	77.89	77.75	76.36	77.79
A12	64.66	62.89	71.06	72.50
A13	59.48	58.83	61.86	62.02

Chart 6. Central Zones color values from HIS in Bleaching GTS Protocol



BLEACHING	ΔE PZ							
GTS	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
A2	61.77	60.61	65.04	67.08	65.29	64.97	64.77	63.59
A5	73.83	66.42	70.93	70.60	63.58	67.70	68.51	69.97
A7	73.64	72.93	76.51	76.20	70.82	73.53	75.35	74.76
A9	72.59	73.85	74.23	79.46	77.82	71.60	72.77	70.63
A1	58.66	60.06	60.73	60.91	60.44	59.52	57.51	58.30
A4	60.85	60.79	62.50	63.40	63.84	63.87	62.17	62.50
A11	72.46	73.24	75.54	73.51	71.69	72.37	75.00	75.82
A12	65.24	64.39	66.86	76.39	79.57	79.64	74.14	67.78
A13	57.55	56.92	58.21	61.65	60.44	61.24	60.62	58.10

Chart 7. Peripheral Zones color values from HSI in Blraching GTS Protocol

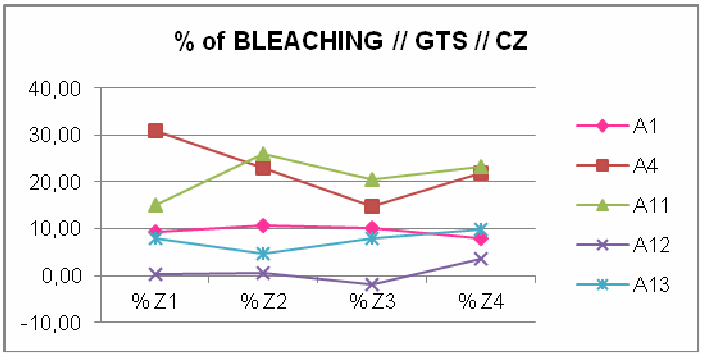
Spite of it is possible to observe new different areas by colour, this is only due to the orientation of the sample in the measuring process. Thus, when considering the two zones (close and far to gum) , the higher color concentration correspond to the close to gum zone.

% Of bleaching

Once all steps of the protocol GTS were finished and measured it was time to calculate % of the bleaching on those target samples, with the formula already described in methodology. For the statistic analysis were performed only with the HSI values, since the colorimeter had shown to be not very quantitative method in comparison with the HSI.

The following results show the existence of areas with a negative percentage indicating a negative bleaching reaction, the total percentage of the zones is positive. This behavior has been presented in bleaching process through time and is one of the main reasons for repetitive whitening in the tooth. The chemical composition in each tooth plays an important role in the uniformity and speed of bleaching.

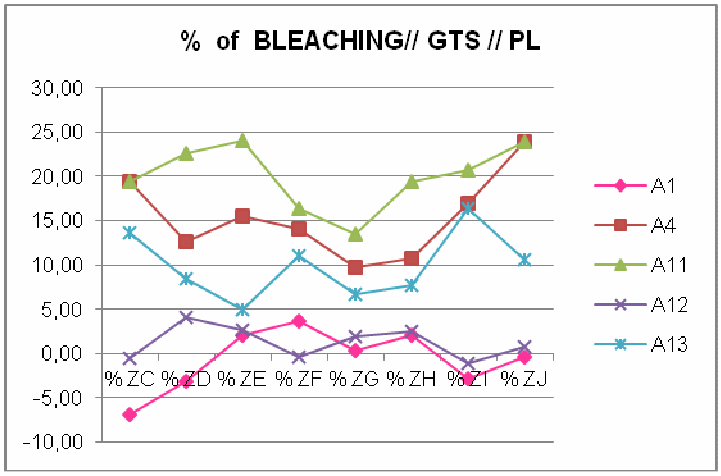
Throughout the whitening process we have observed areas with greater color contraction, zones 3, and 4. In the percentage of bleaching, we can see that the areas are 4 and 2, although there is a different area. It is due to the position of the sample in the acquisition, with a cross-section we see that there is a constant relationship with the dental morphology and color concentration zones as in Chart 8.



GTS	BLEACHING %				
CZ	% Z1	% Z2	% Z3	% Z4	% TOTAL CZ
A1	9.39	10.58	10.21	8.05	9.56
A4	30.87	23.05	14.79	21.93	22.66
A11	15.12	26.09	20.38	23.16	21.19
A12	0.18	0.66	-2.02	3.47	0.57
A13	7.85	4.71	8.00	9.75	7.58

Chart 8. Percentage of Bleaching values in central zones from HIS of GTS Protocol.

Central zone presents a similar behavior that the peripheral zone. The highest percentages of bleaching are I and J as we can see in Chart 9. We found a correspondence of these zones with the central and gum cervix area in the incisors teeth.



GTS	BLEACHING %								
SZ	% ZC	% ZD	% ZE	% ZF	% ZG	% ZH	% ZI	% ZJ	% TOTAL PZ
A1	-6.92	-3.15	2.09	3.65	0.32	2.10	-2.80	-0.38	-0.64
A4	19.44	12.56	15.54	14.01	9.77	10.67	16.98	23.90	15.36
A11	19.45	22.61	24.03	16.39	13.48	19.46	20.69	23.94	20.01
A12	-0.56	4.06	2.64	-0.47	1.92	2.53	-1.12	0.78	1.22
A13	13.57	8.40	5.00	11.02	6.69	7.68	16.39	10.55	9.91

Chart 9.Percentage of Bleaching values in peripheral zones from HIS of GTS Protocol.

As It has been describe in methodology a second protocol was applied and compared the differences between protocols in the steps and color values.

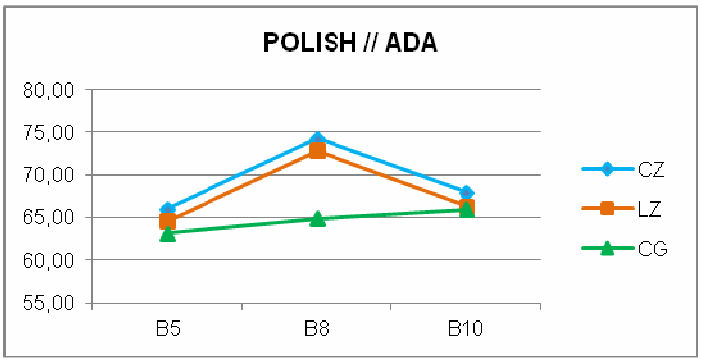
Protocol ADA

Polish

The American Dental Association (ADA) has ordered the completion of this first step in their protocol because it helps to remove irregularities on the tooth surface. Since the analytical methods for the color measurement work with the quantification of the light reflected by the sample, a flat surface is important.

In our case and because of the conditions for color measurement in the HSI, it was not possible to include polished samples from GTS protocol, so we are going to take these measurements as a basis for both protocols in the obtained results.

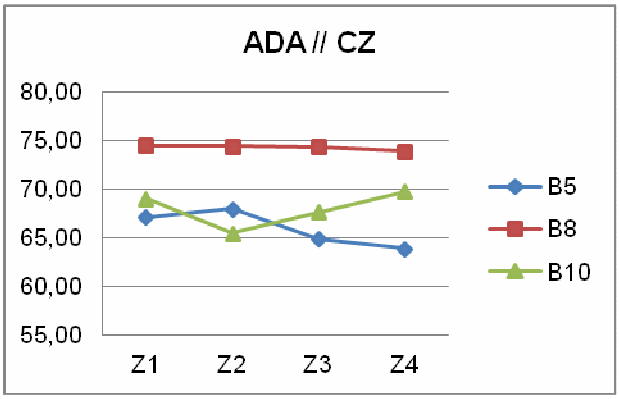
Chart 10 shows the same trend that has been reflected in the protocol GTS, where we see a match between the two zones of the HSI measurements, Although some results of the colorimeter values seem close to the values of HSI, it is not possible to assure these values to the tooth surface, since the measured signal may also contain area from the polymer holder.



ΔE			
POLISH	CZ	LZ	GC
B5	65.99	64.61	63.15
B8	74.30	72.86	64.91
B10	68.00	66.35	65.96

Chart 10. Total color from HSI and Colorimeter in Polish ADA Protocol

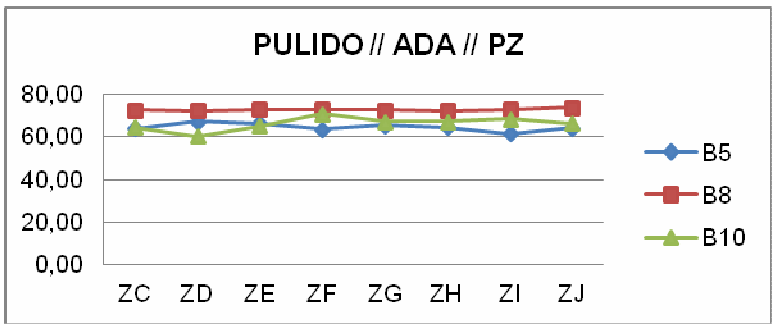
We note that the highest ΔE average is in the 1 and 2 of the central zones as found in Chart 11, observing that the area corresponding to this zone is the center cervix incisors, identified by a transversal cut of the target sample.



POLISH	CENTRAL ZONES ΔE			
ADA	Z1	Z2	Z3	Z4
B5	67.11	68.01	64.91	63.93
B8	74.51	74.44	74.35	73.91
B10	69.02	65.49	67.69	69.78

Chart 11. Central Zones color from HSI in Polish ADA Protocol

In Chart 12 values correspond to peripheral zones, as seen, the highest values of ΔE are located in zone F and G. We noticed that these areas correspond to the gum cervix incisors (identified as in the previous case).



POLISH	PERIPHERAL ZONES ΔE							
ADA	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
B5	63.81	67.31	66.46	63.69	65.44	64.45	61.53	64.17
B8	72.67	72.35	72.82	73.00	72.77	72.45	72.83	74.00
B10	64.53	60.48	65.27	70.97	67.29	67.23	68.59	66.41

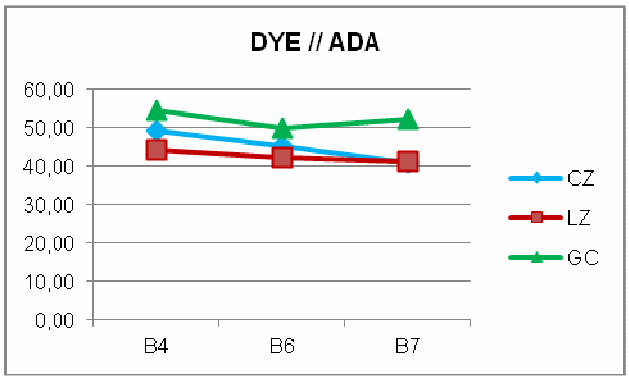
Chart 12. Peripheral Zones color from HSI in Polish ADA Protocol

Dye

In the methodology we already explained this step of the protocol. We must remember that wine is a strong dye chromophore, which not only stains the dental tissues, but also in a wide variety of materials.

Analyzing the color averages of this polishing step, we clearly see a color increase, which indicates that the staining was performed successfully. In this case, the method HSI still show similar values for the considered zones. See Chart 13

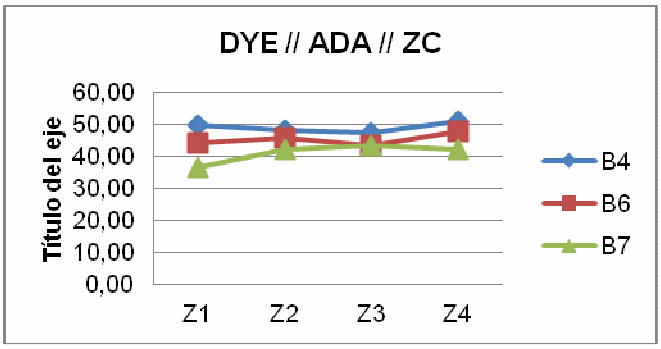
On the other hand, the colorimeter values reflect some major points of agreement with HSI values. This behavior made us check the colorimeter calibration again and repeat the data acquisition. We may say that this protocol has led to more homogeneous staining of teeth samples than the GTS protocol. Spite of the previously observed disparity, in this case, the colorimeter measurements are similar to HSI. This similarity may be due to the higher and more homogeneous color obtained in this protocol.



DYE	ΔE		
ADA	CZ	LZ	GC
B4	49.23	44.22	54.61
B6	45.31	42.26	49.92
B7	40.99	41.37	52.11

Chart 13. Total color from HSI and Colorimeter in Dye ADA Protocol

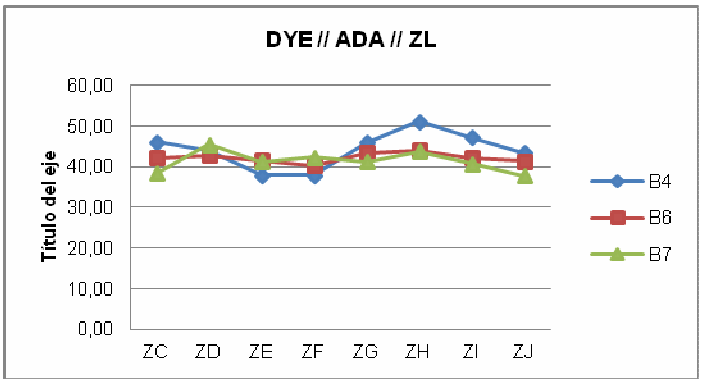
Higher values of HSI central areas are in zone 4 and 2 as it is shown in Chart 14, the cross section indicates a match on tooth morphology. The zone 4 corresponds to gum cervix. One might think that the zone 2 is an inconsistency in the results, but it is not. Due to the position of the teeth and how the quadrants division was performed in the data acquisition zone 2 corresponds to the central and gum region of the tooth cervix.



DYE	CENTRAL ZONES ΔE			
ADA	Z1	Z2	Z3	Z4
B4	49.98	48.32	47.57	51.06
B6	44.10	45.78	43.35	47.99
B7	36.40	42.01	43.31	42.26

Chart 14. Central zones color from HSI in Dye ADA Protocol

In peripheral zones, the highest values correspond to H and D zones, same as it was mentioned in the central zones, H and D zones corresponds to central and gum cervix.



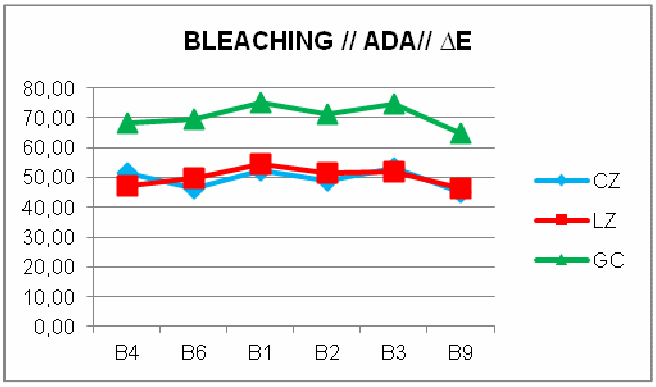
DYE	PERIPHERAL ZONES ΔE							
ADA	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
B4	46.13	43.95	37.93	37.96	45.97	51.13	47.19	43.52
B6	42.18	42.81	41.55	40.25	43.53	44.05	42.27	41.41
B7	38.35	45.53	41.21	42.31	41.20	43.71	40.76	37.86

Chart 15. Peripheral zones color values in Dye ADA Protocol.

Bleaching

The bleaching process was carried according to the manufacturer's instructions as it is mention in the methodology. The following results show that the correlation between the

results of HSI does not vary and the disparity from colorimeter values persists. Likewise, we find that there is a trend pattern of values between the two techniques, as shown in.Chart 16.

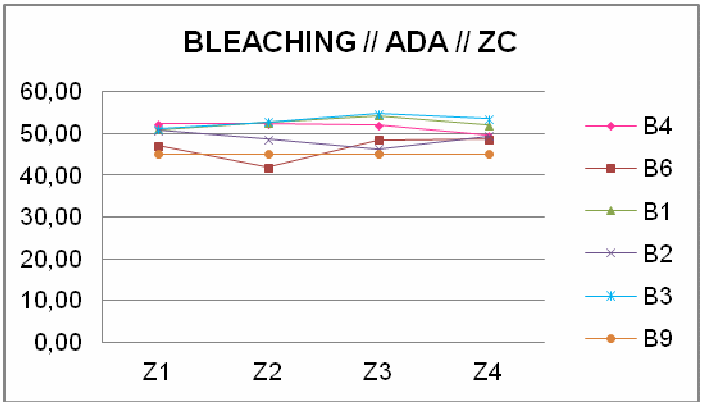


BLEACHING	ΔE		
	CZ	LZ	GC
B4	51.48	47.00	68.22
B6	46.48	49.85	69.58
B1	52.44	54.30	75.19
B2	48.75	51.28	71.15
B3	53.00	51.91	74.58
B9	45.15	46.45	64.78

Chart 16. Total color from HSI and Colorimeter in Bleaching ADA Protocol

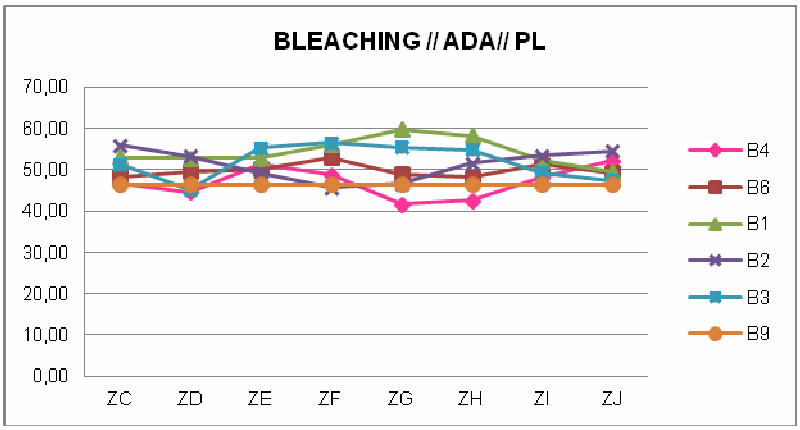
If we observe the results of whitening of the GTS protocol we see that ΔE values are much lower in ADA protocol. This indicates that there is higher tooth staining in this protocol and in order to achieve desired whitening, it is necessary to performed a series of repetitions in the application of the bleaching agent. These repetitions may cause a significant changes on the tooth surface.

The highest color concentration values are found in zones 3 and 4 (Chart 17). The cross section indicates that these regions belong to the gum cervix, as in the previous cases.



BLEACHING	CENTRAL ZONES ΔE			
ADA	Z1	Z2	Z3	Z4
B4	52.25	52.22	51.99	49.45
6	47.13	41.83	48.42	48.54
B1	50.88	52.59	54.27	52.01
B2	50.74	48.62	46.29	49.32
B3	51.02	52.75	54.70	53.55
B9	45.15	45.15	45.15	45.15

Chart 17. Central zones color values from HSI in Bleaching ADA Protocol



BLEACHING	PERIPHERAL ZONES ΔE							
ADA	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
B4	46.55	44.55	51.40	48.80	41.67	42.64	48.18	52.18
B6	48.38	49.59	50.24	52.98	48.92	48.15	51.21	49.30
B1	52.98	52.84	52.87	56.01	59.79	58.30	52.11	49.51
B2	55.88	53.33	49.20	45.70	46.65	51.61	53.35	54.54
B3	51.28	45.22	55.29	56.57	55.50	54.81	49.25	47.38
B9	46.45	46.45	46.45	46.45	46.45	46.45	46.45	46.45

Chart 18. Peripherals zones color values from HSI in Bleaching ADA Protocol

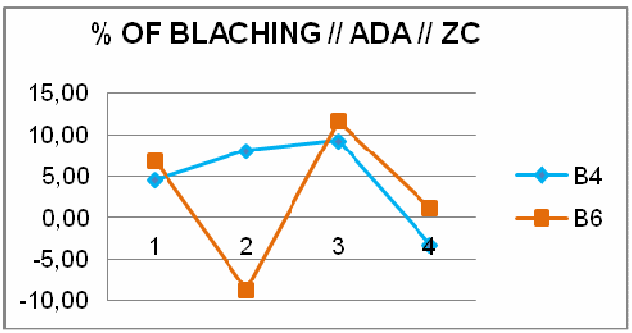
Values obtained in the peripheral zones indicate that E and F correspond to the higher color concentration values like in Chart 18. With the cross section we are able to observe that these zones are located in the tooth cervix center.

% Of bleaching

To determine the protocol bleaching success we used the expression indicated in the methodology. These calculations were performed only with measurements taken by the HSI, since global measures have shown to be somewhat erratic and not very qualitative.

Results of Chart 19 observe negative results. This means that there has been no whitening in those areas, but despite these negative values in some zones the total percentage of whitening is positive. Most bleaching processes consist in several repetitions for a long period of time, since the whitening process is not uniform for all patients, and even less for the entire tooth surface. Thus, negatives values are reliable.

One more time we note that zone 3 has the highest values in the percentage of bleaching. With the cross section we realize that this area corresponds to the boundary between the central and upper cervix of the incisors.

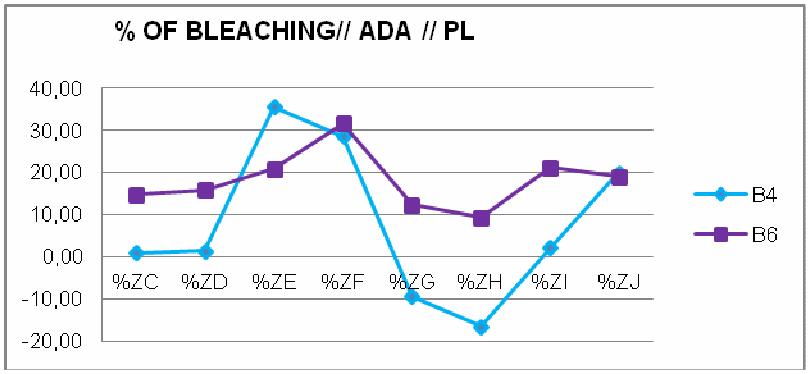


% OF BLEACHING // ADA // ZC					
	%Z1	%Z2	%Z3	%Z4	% TOTAL ZC
B4	4.54	8.08	9.29	-3.16	4.69
B6	6.87	-8.64	11.69	1.15	2.77

Chart 19. Percentage of Bleaching in central zones from HSI ADA Protocol

In peripheral zones, the highest percentage values in bleaching are E and F zones see Chart 20. These areas correspond to the central part of the cervix of the incisors.

Here negative values are also present and similarly the total percentage of bleaching is positive like in the central zones. Unlike values in the GTS protocol we observed lower values in ADA protocol. These results can be attributed to the large amount of deposited chromophores in the staining step of ADA protocol and the limited effectiveness of a single application of the bleaching gel.



% OF BLEACHING // P. ADA // PL									
	%ZC	%ZD	%ZE	%ZF	%ZG	%ZH	%ZI	%ZJ	% TOTAL ZL
B4	0.91	1.36	35.50	28.55	-9.35	-16.60	2.08	19.91	7.80
B6	14.70	15.83	20.91	31.61	12.39	9.31	21.15	19.05	18.12

Chart 20. . Percentage of Bleaching in peripheral zones from HSI ADA Protocol

Fo r both protocols we have observed significant color changes in each stages. The HSI has proven to be not only a qualitative method for color measurement, but also allowed us to see the image of the sample with a little more detail. During the color analysis of the image we have observed changes in the tooth surface, which leads us to ask: How the tooth surface is affected in the whitening process?.

In odontology there is considerable debate about the teeth whitening process and its impact on the tooth surface. There have been numerous studies on the structure of the surface at the end of the bleaching process, and how etching affects dental restorations. But so far there has been no study to help us understand the whole process that passes the tooth surface at different stages of the bleaching process.

ROUGHNESS

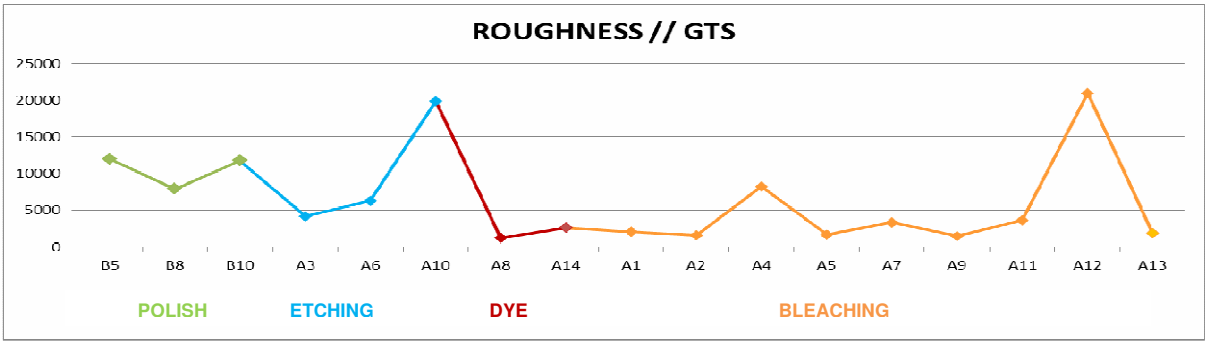
To answer the previous question we decided to run out a study of the roughness in each stages of the two protocols, through a dual confocal microscope. As we already said in polish step for ADA protocol this values are going to be taken as the start point for this analysis in both protocols.

The graphics will show the differences in roughness between the samples and protocol steps

The mayor parameters to take into account are the average roughness (Sa), for a general view of the surface structure. The roughness data can be found in Annex #.4

Protocol GTS

The following graphic represent the entire roughness (Sa) analysis for the protocol GTS.



GTS	POLISH			ETCHING			DYE	
nm	B5	B8	B10	A3	A6	A10	A8	A14
Sa	12012	7890.28	11806.2	4181.9	6300.65	19896.8	1258.07	2659.82

GTS	BLEACHING								
nm	A1	A2	A4	A5	A7	A9	A11	A12	A13
Sa	2086.48	1601.85	8246.55	1688.27	3329.63	1483.11	3638.98	20987	1901.79

Chart 21. Roughness in GTS Protocol

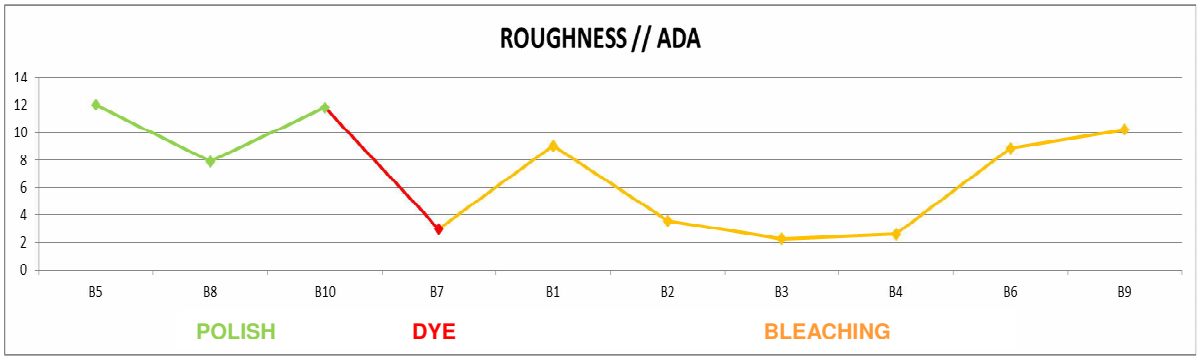
Given that the tooth is the subject of the dental demineralization and remineralization activity of food acids and dental treatments, the initial roughness of tooth, must be higher than the following steps in both protocols

Since the objective of the etching step was cleaning the surface and many studies reflect an erosion on the surface, we may think that roughness will increase.[55, 56] However, the trend of the graph is the decrease of the roughness as it evolves through the teeth whitening process with some exceptions to this behavior, due to the different nature of target samples.

According to Chart 21 the roughness is heterogeneous in the whole protocol. The average roughness (Sa) is reflected in N8, N9 rugosity for two third of the samples meaning that the roughness can be observed with an optical microscope but it is not sensible to touch. For the third part is N11 - 12 the brands are appreciated by sight and touch. The roughness class tables are added in Annex No. 5

Protocol ADA

The following graphic represent the entire roughness (Sa) analysis for the protocol ADA.



ADA	POLISH			DYE	BLEACHING					
	B5	B8	B10	B7	B1	B2	B3	B4	B6	B9
Sa (µm)	12.012	7.89028	11.8062	2.96333	9.01701	3.55785	2.25892	2.57868	8.8402	10.205

Chart 22. Roughness in ADA Protocol

We can see that the roughness in the samples decreases at each step of the protocol. Chart 22. Although some samples show a different behavior, the behavior of these samples is fully independent because of the nature and physiology of each one.

Another factor to be considered is the area in which measurements were taken, since in most cases the irregularities on the surface are visible for the human eye in both protocols. In odontology a low roughness prevents from plaque adhesion on the surface. We can conclude that the level of roughness in the samples decreases at each stage of bleaching in both protocols, so a surface results whiter and less rough.

CONCLUSIONS

Conclusions

In the course of this research were characterized 24 dental tissue samples, They were divided into two whitening protocols. The color characterization was carried out using the technique of High Spectral Image HSI and the conventional colorimeter.

- THE HSI allowed us to obtain high-quality reconstructed images; this made possible a high efficiency color assessment in contrast to the colorimeter measures. The colorimeter showed very high variation in the repeatability of the measurements. We can conclude that HSI is a technique that can be used in odontology with a high quality in color assessment

- The protocols used in this study showed significant differences. Polishing and Etching processes are not possible to compare since there are two different stages. But it is possible to say that dental color is affected by the etching because the color concentrations are higher than in the polishing stage.

- GTS protocol showed being less aggressive in the dye stage than ADA's protocol. ADA's showed total color concentration values higher. We attributed this behavior to a deep staining of dentin due to a more acid pH staining solution of ADA protocol.

- In bleaching the results were variable; in a general view GTS had a better percentage of bleaching than ADA's. This was due to deep dentin dye in the previous step that might be solved with a deep dentin bleaching.

- During the whitening process the HSI results showed some zones with a higher concentration in color than others. Due the incisors morphology the whitening process is not homogeneous. The central to the gum cervix zone in the incisors is the area where we could find the conditions for a better color absorbance and reflection.

- In the analysis of surface roughness we concluded that It is dependent with the whitening process. A higher whiteness and dental brightness, the lower the roughness, which means there is a change in the tooth surface due to the bleaching process. However whitening in vivo counteracts this effect due to the natural tooth remineralization.

REFERENCES

1. Propiedades mecánicas de la dentina humana, Fuentes Fuentes Ma V :::

2. Phillips' Science of Dental Materials. Kenneth J. Anusavice

3. Teeth . Simon Hilsson, Second edition

4. Hunsaker KJ, Christensen GJ. Tooth bleaching chemicals influence of teeth and restaurations. J Dent Res. 1990; 9: 303.

5. 2. Fasanaro TE. History, safety and effectiveness of current bleaching technique and applications of the night guard vital technique. Quintessence Int. 1992; 23(7): 471-485.

6. Andiara Ribeiro Roberto afernanda F. [A] Departament of Restorative Dentistry, UNESP – Univ Estadual Paulista, Araraquara School of Dentistry, Araraquara, SP, Brazil Evaluation of tooth color after bleachingwith and without light-activation

7. Joiner A, Jones NM, Raven SJ. Investigation of factors influencing stain formation utilizing an in situ model. Advances in Dental research 1995;9:471–6.

8. Arora, M. G. *Periodic table and periodic properties*; Anmol Pub. Pvt Ltd.: New Delhi, India, 1997.

9. Sharma, V. K. *Adv. Environ. Res.* 2002, *6*, 143.

10. Van der Vyver PJ, Lewis SB, Marais JT. The effect of bleaching agent on composite/enamel bonding. J Dent Assoc S Afr. 1997 Oct; 52(10):601-3.

11. Bard, A. J.; Parsons, R.; Jordan, J. *Standard Potentials in Aqueous Solutions*; Marcel Dekker Inc.: New York, 1985.

12. Latimer, W. M. *Oxidation potentials*, 2nd ed.; Prentice-Hall Inc.: Englewood Cliffs, NJ, 1952.

13. Eberson, L. *Electron Transfer Reactions in Organic Chemistry*; Springer: Berlin, Germany, 1987.

14. Goldstein R, Garber D. Complete Dental Bleaching. Quintessence Books.1995.

15. Enric Brillas,† Ignasi Sire´s,† and Mehmet A. Oturan*,‡Electro-Fenton Process and Related Electrochemical Technologies Based on Fenton's Reaction Chemistry *Chem. Rev.* 2009, *109,* 6570–6631

16. Andrew Joiner * The bleaching of teeth: A review of the literature Unilever Oral Care, Quarry Road East, Bebington, Wirral, CH63 3JW, UK

17. Warren, M.A. y cols. An In Vitro Comparison of Bleaching Agents on the Crowns and Roots of Discolored Teeth. J Endod 1990;16(10):463-467

18. Calderón R. Blanqueamiento dental con gases hiperoxidantes (ozono) para dientes vitales [en línea] 2004 [fecha acceso 5 de junio del 2005]; Disponible en: http://www.odontologiaonline.com /casos/part/RCA/RCA03/rca03.

19. Crispín. Procedimientos estéticos no restauradores. En: bases prácticas de odontología estética. España – Masson S.A. 1998 Vol.1: 24-46

20. Carrillo A., Arredondo MV., Haywood V.: (1.998) Simultaneous bleaching of vital teeth and an open–chamber nonvital tooth with 10% carbamide peroxide. Quintessence Int., 29: 643-648

21. Ernst C., Briceño B., Willershausen-Zönnchen B.: (1.997) Efectos de los agentes blanqueantes con peróxido de hidrógeno sobre la morfología del esmalte humano. Quintessence (ed. Esp.), 10 (1): 13-16.

22. Feinman RA.: (1.995) Safe and effective bleaching. Ultradent Restaurative Monograph, 11-18.

23. Luis H. Gálvez. Mecanismos de transporte del fluido dentinario. Bases estructurales. Odontologia Sanmarquina Vol 8 N 2 Julio – Dicienbre 2004 .

24. Feinman RA., Mandray G., Yarborough D.: (1.991) Chemical, optical, and physiologic mechanisms of bleaching products: A review. The Bleaching Report

25. Enrique Ríos Salia, hipersensibilidad dental, Congreso Nacional e Internacional Tèmatico de Estomatologia Integral Edición Especial No. 7-2003, Universidad Universidad Nacional Autónoma de México.

26. Homson Reuters Web Of Knowledge, VR 1.0, PT J, AU Markowitz, Kenneth TI Pretty Painful: Why Does Tooth Bleaching Hurt?, So Medical Hypotheses VL 74,IS 5,BP 835, EP 840, DI 10.1016/J.Mehy.2009.11.044, PD MAY 2010, PY 2010

27. Salgado Aguayo, Alfonso Rafael; Vaca Domínguez, Luis Alfonso Las Bases Moleculares De La Percepción De Temperatura En El Humano Revista De Educación Bioquímica, Vol. 28, Núm. 2, Junio, 2009, Pp. 36-41 Universidad Nacional Autónoma De México, Distrito Federal, México.

28. CIE (1932). Commission Internationale de l'Eclairage proceedings, 1931. Cambridge: Cambridge University Press.

29. Smith, Thomas; Guild, John (1931–32). "The C.I.E. colorimetric standards and their use". Transactions of the Optical Society 33 (3): 73–134. Doi:10.1088/1475-4878/33/3/301.

30. Gernot Hoffmann cielab Color Space, Gernot Hoffmann February 03 / 2003 + January 31 / 2013

31. Odontología estética: Apreciacion cromática en la clínica y el laboratorio Agustín Pascual Moscardó 1, Isabel Camps Alemany 2 *Clínica Odontológica Gascó Oliag, 146021 – valencia*recibido: 24-11-2005

32. Reflectance spectrophotometry and colorimetry, *PP Handbook , Peter Blum , November, 1997*

33. An introduction to hyperspectral imaging technology, 12121 wilshire boulevard, suite 910 los angeles, ca 90025-1123

34. Rugosidad de las superficies, Topometría. Moises Hinojosa Rivera.

35. Lee BS, Huang SH, Chiang YC, Chien YS, Mou CY, Lin CP. Development of in vitro tooth staining model and usage of catalysts to elevate the effectiveness of tooth bleaching. Elsevier, Dental Materials Volume 24, Issue 1, January 2008, Pages 57–66.

36. In: Howe-Grant M, editor. Encyclopedia of chemical technology, 4th ed., vol. 4. New York: John Wiley and Sons; 1992. P. 290–1.

37. In: Howe-Grant M, editor. Encyclopedia of chemical technology, 4th ed., vol. 13. New York: John Wiley and Sons; 1992.

38. ADA Professional Product Review In-Office Whitening Agents: Laboratory Testing Methods, Volume 3, Issue 2, Spring 2008.

39. Pilar Ortiz Alías. Tesis doctoral. Aplicacion de Microscopia Electrónica y Radiacion Sincrotrón al estudio de materiales y procesos avanzados para la salud y estética dental.

40. Lee BS, Huang YC et. Al. Development of invitro toothstaining model and usage of catalysts to elevate the effectiveness of tooth bleaching. Dent. Master, 2008, 24(1): 56-66.

41. H. Li, C.-W. Fu, A. J. Hanson, Visualizing multiwavelength astrophysical data, in: IEEE Transactions on Visualization and Computer Graphics (Proceedings of IEEE Visualization), vol. 14, 2008, pp. 1555–1562.

42. C. Collet, M. Louys, A. Oberto, C. Bot, Markov model for multispectral image analysis: application to small magellanic cloud segmentation, in: Proceedings of IEEE International Conference on Image Processing, 2003, pp. 953–956.

43. M.A. Loghmari, M.S. Naceur, M.R. Boussema, A spectral and spatial source separation of multispectral images, IEEE Transactions on Geoscience and Remote Sensing 44 (2006) 3659–3673.

44. Q. Du, C.-I. Chang, A linear constrained distance-based discriminant analysis for hyperspectral image classification, Pattern Recognition 34 (2001) 361–373.

45. Z. Pan, G. Healey, M. Prasad, B. Tromber, Face recognition in hyperspectral images, IEEE Transactions on Pattern Analysis and Machine Intelligence 25 (2003) 1552–1560.

46. A Study of Efficiency and Accuracy in the Transformation from RGB to CIELAB Color Space Christine Connolly and Thomas Fliess

47. Priniples of Colorimetry, Donal J Lovell, Naval Research laboratory, Washington 20, D.C.

48. Leica DCM 3D pdf. Http://www.leica-microsystems.com/fileadmin/downloads/Leica%20DCM%203D/Brochures/Leica_DCM3D_Brochure_ES.pdf.

49. E.S. Gadelmawla· Roughness parameters, M.M. Koura[b], T.M.A. Maksoud[c,] I.M. Elewa[a], H.H. Soliman[d]. Journal of Materials Processing Technology Volume 123, Issue 1, 10 April 2002, Pages 133–145.

50. Pugach, M. K., Strother, J., Darling, C. L., Fried, D., Gansky, S. A., Marshall, S. J. & Marshall, G. W. 2009, 'Dentin Caries Zones: Mineral, Structure and Properties', *J Dent Res,* vol. 88, pp. 71-76.

51. Guilherme Carpena Lopes, DDS, MS, phd Enamel Acid Etching: *A Review* Department of Operative Dentistry Universidade Federal de Santa Catarina School of Dentistry Florianópolis, Brazil

52. Simona Stoleriu1, Gianina Iovan2, Galina Pancu1, A. Georgescu1,
Antonia Moldovanu1, S. Andrian3 study on the effects of acid etching on affected enamel

53. Roberto Espinosa / Roberto Valencia / Mario Uribe / Israel Ceja / Marc Saadia Enamel Deproteinization and Its Effect on Acid Etching: An *in Vitro* Study

54. Sem analysis of the acid-etched enamel patterns promoted by acidic monomers and phosphoric acids Mirela Sanae SHINOHARA1 , Marcelo Tavares de OLIVEIRA1, Vinícius Di HIPÓLITO1, Marcelo GIANNINI2, Mario Fernando de GOES3 Dat

55. Ten Bosch JJ, Coops JC. Tooth color and reflectance as Related to light scattering and enamel hardness. Journal of Dental Research 1995;74:374–80.

56. In vitro evaluation of human dental enamel surface roughness bleached with 35% carbamide peroxide and submitted to abrasive dentifrice brushing Claudia Cia Worschech*José Augusto Rodrigues

GTS PROTOCOL ETCHING

CZ														
ETCHING A6	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	7.59	7.32	8.05	7.96	1	14.76	14.68	14.51	14.30	1	72.54	73.42	72.49	73.10
2	7.31	7.63	8.14	8.43	2	15.52	14.38	13.21	14.88	2	72.87	72.64	73.36	73.26
3	7.51	7.77	8.83	7.78	3	11.92	12.22	14.62	15.61	3	71.77	70.28	73.55	73.34
4	7.94	7.60	9.55	7.67	4	12.35	12.26	15.13	14.52	4	71.01	71.65	72.20	72.80
5	7.74	7.42	7.42	8.04	5	13.84	13.72		14.87	5	72.15	72.75	72.24	73.25
6	7.66	7.52	9.62	8.30	6	13.02	11.54	14.53	13.85	6	71.61	71.26	71.95	73.24
7	7.43	7.53	8.23	7.80	7	14.87	13.22	15.01	15.00	7	72.63	71.45	72.52	73.39
8	7.51	7.57	8.42	7.57	8	13.30	14.32	15.56	15.25	8	72.48	72.45	72.95	73.03
9	7.90	7.45	8.11	7.61	9	12.03	14.35	15.46	15.75	9	72.15	71.64	73.34	73.07
10	7.38	7.21	7.79	7.76	10	12.22	14.07	14.94	14.67	10	71.92	71.26	73.85	73.68
AVERAGE	7.60	7.50	8.42	7.89	AVERAGE	13.38	13.48	15.05	14.87	AVERAGE	72.11	71.88	72.85	73.22

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-0.03294	-1.13514	-0.51033	0.23503
x2	-1.35058	0.79834	-0.38484	1.85953
x3	-0.40941	1.67152	0.57725	-0.38711
x4	1.61411	0.61123	1.58117	-0.76731
x5	0.67294	-0.51144	-1.38876	0.51154
x6	0.29647	0.11227	1.67878	1.41020
x7	-0.78588	0.17464	-0.25935	-0.31799
x8	-0.40941	0.42412	0.00558	-1.11295
x9	1.42588	-0.32433	-0.42667	-0.97470
x10	-1.02117	-1.82121	-0.87285	-0.45624

b	Z1	Z2	Z3	Z4
x1	1.05226	1.08781	-0.49384	-0.98543
x2	1.63303	0.81676	-1.67616	0.01729
x3	-1.11798	-1.13479	-0.39380	1.27933
x4	-0.78939	-1.09865	0.07003	-0.60509
x5	0.34922	0.22045	2.28005	0.00000
x6	-0.27739	-1.74917	-0.47566	-1.76340
x7	1.13632	-0.23130	-0.03911	0.22475
x8	-0.06343	0.76255	0.46110	0.65695
x9	-1.03392	0.78966	0.37016	1.52137
x10	-0.88873	0.53668	-0.10277	-0.34577

L	Z1	Z2	Z3	Z4
x1	0.76766	1.66980	-0.54326	-0.48872
x2	1.36093	0.82406	0.78812	0.18538
x3	-0.61664	-1.73485	1.07888	0.52242
x4	-1.98296	-0.24939	-0.98706	-1.75264
x5	0.06652	0.94333	-0.92585	0.14324
x6	-0.90429	-0.67226	-1.36964	0.10111
x7	0.92946	-0.46624	-0.49736	0.73308
x8	0.65979	0.61804	0.16068	-0.78363
x9	0.06652	-0.26023	0.75751	-0.61511
x10	-0.34697	-0.67226	1.53798	1.95487

Descriptive statistics of a *				
Media	7.5970	7.5020	8.4160	7.8920
Error típico	0.0672	0.0507	0.2268	0.0915
Mediana	7.5500	7.5250	8.1850	7.7900
Moda	7.5100	#N/A	#N/A	#N/A
Desviación estándar	0.2125	0.1603	0.7172	0.2893
Varianza de la muestra	0.0452	0.0257	0.5144	0.0837
Curtosis	-0.8502	0.2717	-0.2510	-0.2269
Coeficiente de asimetría	0.4561	-0.3029	0.7289	0.8944
Rango	0.6300	0.5600	2.2000	0.8600
Mínimo	7.3100	7.2100	7.4200	7.5700
Máximo	7.9400	7.7700	9.6200	8.4300
Suma	75.9700	75.0200	84.1600	78.9200
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.1520	0.1147	0.5130	0.2070

Descriptive statistics of b*				
Media	13.3830	13.4760	15.0530	14.8700
Error típico	0.4138	0.3500	0.3477	0.1829
Mediana	13.1600	13.8950	14.9750	14.8750
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3086	1.1068	1.0995	0.5784
Varianza de la muestra	1.7125	1.2250	1.2090	0.3346
Curtosis	-1.3399	-1.0356	3.3254	-0.1956
Coeficiente de asimetría	0.4600	-0.7248	0.9726	-0.1102
Rango	3.6000	3.1400	4.3500	1.9000
Mínimo	11.9200	11.5400	13.2100	13.8500
Máximo	15.5200	14.6800	17.5600	15.7500
Suma	133.8300	134.7600	150.5300	148.7000
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9361	0.7918	0.7866	0.4138

Descriptive statistics of L*				
Media	72.1130	71.8800	72.8450	73.2160
Error típico	0.1759	0.2916	0.2066	0.0751
Mediana	72.1500	71.6450	72.7350	73.2450
Moda	72.1500	71.2600	#N/A	#N/A
Desviación estándar	0.5562	0.9223	0.6535	0.2374
Varianza de la muestra	0.3094	0.8506	0.4270	0.0563
Curtosis	0.2447	-0.2589	-1.4983	1.1131
Coeficiente de asimetría	-0.6596	0.0455	0.1686	0.2504
Rango	1.8600	3.1400	1.9000	0.8800
Mínimo	71.0100	70.2800	71.9500	72.8000
Máximo	72.8700	73.4200	73.8500	73.6800
Suma	721.1300	718.8000	728.4500	732.1600
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.3979	0.6598	0.4675	0.1698

ETCHING A6	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	8.02	8.29	8.31	9.8	9.88	8.48	8.62	
2	7.64	8.24	8.87	8.65	9.38	8.71	8.92	9.65
3	8.12	9.56	8.63	9.69	9.40	8.85	10.24	9.11
4	9.43	8.93	8.55	9.83	9.14	10.34	10.45	9.34
5	8.99	8.3	9.41	10.89	10.80	9.65	9.45	8.64
6	7.84	8.44	9.32	9.82	9.73	9.90	10.32	9.26
7	8.69	9.08	10.16	8.74	10.22	9.58	8.76	9.34
8	7.59	9.07	9.36	10.24	10.35	8.80	9.55	9.65
9	9.04	8.56	9.35	8.03	10.09	8.61	8.97	9.11
10	8.28	9.42	9.55	10.74	9.51	9.13	8.91	9.30
AVERAGE	8.36	8.79	9.15	9.64	9.85	9.21	9.42	9.27

PZ								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	13.06	11.31	12.44	15.47		15.83	15.83	14.36
2	12.37	11.63	13.95	13.64	16.48	14.40	12.86	14.07
3	14.46	11.23	13.95	15.14	15.02	15.63	14.26	13.56
4	11.8	12.24	13.24	15.39	16.38	14.71	14.04	11.19
5	12.17	11.68	12.91	14.96	15.67	15.57	15.03	12.07
6	11.44	11.87	14.01	15.46	15.52	15.61	14.31	12.21
7	11.52	11.4	13.66	15.22	16.33	15.52	13.51	12.39
8	13.31	11.59	15.24	15.31	15.63	15.98	14.18	15.05
9	11.03		15.71		16.11	16.60	14.69	12.44
10	11.96	12.04	15.07	15.42	16.67	15.89	14.76	12.83
AVERAGE	12.31	11.67	14.02	15.11	15.98	15.57	14.35	13.02

PZ								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	69.98	69.61	68.87	71.29	71.56	73.36	72.98	72.45
2	70.3	68.84	71.19	71.88	71.79	72.99	72.55	71.22
3	67.94	66.63	70.55	71.45	73.27	72.72	71.92	71.88
4	68.88	67.7	69.66	70.54	72.31	71.30	73.21	70.25
5	68.24	68.62	67.07	69.91	71.30	71.82	72.90	71.38
6	70.09	68.11	67.48	70.36	72.44	71.57	72.91	70.50
7	68.48	67.42	67.49	70.52	71.50	71.70	73.06	70.89
8	69.89	67.09	68.02	69.38	71.08	72.54	72.44	70.44
9	69.18	66.99	69.5	70.69	72.23	73.15	72.71	71.29
10	69.62	65.88	68.82	70.33	71.88	73.26	72.56	71.06
AVERAGE	69.26	67.69	68.87	70.64	71.94	72.44	72.72	71.14

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.53839	-1.02335	-1.51453	0.17072	0.05803	-1.15759	-1.14937	-2.34011
x2	-1.13312	-1.12589	-0.50604	-1.07980	-0.90913	-0.79036	-0.71782	1.01701
x3	-0.38188	1.58117	-0.93825	0.05111	-0.87044	-0.56682	1.18101	-0.04937
x4	1.66838	0.28916	-1.08232	0.20335	-1.37336	1.81223	1.48310	0.40483
x5	0.97974	-1.00285	0.46643	1.35600	1.83760	0.71052	0.04459	-0.97751
x6	-0.82010	-0.71573	0.30435	0.19247	-0.23212	1.10969	1.29610	0.24685
x7	0.51022	0.59679	1.81708	-0.98193	0.71570	0.59876	-0.94798	0.40483
x8	-1.21137	0.57628	0.37638	0.64919	0.96716	-0.64666	0.18844	1.01701
x9	1.05800	-0.46964	0.35837	-1.75400	0.46424	-0.95003	-0.64589	-0.04937
x10	-0.13147	1.29406	0.71855	1.19289	-0.65767	-0.11975	-0.73220	0.32584

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.72386	-0.92879	-1.50279	-0.15884	-2.59745	0.40963	1.81678	1.11799
x2	0.05613	-0.31975	-0.06476	-0.92175	0.68714	-1.87856	-1.82168	0.87657
x3	2.07869	-1.08105	-0.06476	-0.29641	-0.47400	0.08961	-0.10658	0.45202
x4	-0.49548	0.84124	-0.74092	-0.19219	0.60761	-1.38252	-0.37610	-1.52089
x5	-0.13742	-0.22458	-1.05519	-0.37145	0.04295	-0.00640	0.83672	-0.78833
x6	-0.84386	0.13703	-0.00762	-0.16300	-0.07635	0.05760	-0.04533	-0.67179
x7	-0.76645	-0.75749	-0.34094	-0.26306	0.56784	-0.08641	-1.02538	-0.52195
x8	0.96580	-0.39588	1.16376	-0.22554	0.01113	0.64965	-0.20459	1.69238
x9	-1.24063	2.26868	1.61136	2.77191	0.39288	1.64174	0.42020	-0.48033
x10	-0.34064	0.46059	1.00186	-0.17968	0.83825	0.50564	0.50595	-0.15567

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.85667	1.70889	0.00364	0.88429	-0.58226	1.18617	0.68293	1.94429
x2	1.23741	1.02391	1.69034	1.68082	-0.22609	0.70861	-0.46418	0.12429
x3	-1.57056	-0.94207	1.22504	1.10030	2.06579	0.36011	-2.14483	1.10088
x4	-0.45213	0.00979	0.57799	-0.12826	0.57916	-1.47271	1.29650	-1.31099
x5	-1.21362	0.82820	-1.30502	-0.97879	-0.98489	-0.80154	0.46952	0.36104
x6	0.98755	0.37451	-1.00693	-0.37127	0.78048	-1.12422	0.49619	-0.94107
x7	-0.92806	-0.23930	-0.99966	-0.15526	-0.67517	-0.95642	0.89635	-0.36400
x8	0.74959	-0.53286	-0.61434	-1.69432	-1.32557	0.12778	-0.75763	-1.02985
x9	-0.09519	-0.62182	0.46166	0.07425	0.45528	0.91512	-0.03735	0.22787
x10	0.42834	-1.60925	-0.03272	-0.41177	-0.08672	1.05710	-0.43750	-0.11246

Descriptive statistics of a *								
Media	8.3640	8.7890	9.1510	9.6430	9.8500	9.2050	9.4190	9.1350
Error típico	0.2021	0.1542	0.1756	0.2908	0.1635	0.1981	0.2198	0.1601
Mediana	8.2000	8.7450	9.3350	9.8100	9.8050	8.9900	9.2100	9.2800
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	9.6500
Desviación estándar	0.6389	0.4876	0.5553	0.9196	0.5170	0.6263	0.6952	0.5064
Varianza de la muestra	0.4082	0.2378	0.3083	0.8457	0.2673	0.3923	0.4833	0.2564
Curtosis	-1.2074	-1.4310	-0.2503	-0.5544	-0.5000	-0.8550	-1.5267	2.8869
Coeficiente de asimetría	0.4032	0.3570	0.1253	-0.4329	0.4553	0.6299	0.5127	-1.5921
Rango	1.8400	1.3200	1.8500	2.8600	1.6600	1.8600	1.8300	1.7000
Mínimo	7.5900	8.2400	8.3100	8.0300	9.1400	8.4800	8.6200	7.9500
Máximo	9.4300	9.5600	10.1600	10.8900	10.8000	10.3400	10.4500	9.6500
Suma	83.6400	87.8900	91.5100	96.4300	98.5000	92.0500	94.1900	91.3500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.4571	0.3488	0.3972	0.6579	0.3698	0.4480	0.4973	0.3622

Descriptive statistics of b *								
Media	12.3120	11.7980	14.0180	15.8510	15.6160	15.5740	14.3470	13.0170
Error típico	0.3268	0.1662	0.3321	0.7585	0.3976	0.1976	0.2581	0.3799
Mediana	12.0650	11.6550	13.9500	15.3500	15.8900	15.6200	14.2850	12.6350
Moda	#N/A	#N/A	13.9500	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.0333	0.5254	1.0500	2.3987	1.2574	0.6249	0.8163	1.2013
Varianza de la muestra	1.0678	0.2761	1.1026	5.7538	1.5810	0.3906	0.6663	1.4430
Curtosis	0.7047	2.1021	-0.7952	8.7113	5.8203	0.8210	0.8162	-0.7455
Coeficiente de asimetría	0.9914	1.3565	0.2430	2.8315	-2.2569	-0.6076	-0.0556	0.3392
Rango	3.4300	1.7600	3.2700	8.8600	4.3200	2.2000	2.9700	3.8600
Mínimo	11.0300	11.2300	12.4400	13.6400	12.3500	14.4000	12.8600	11.1900
Máximo	14.4600	12.9900	15.7100	22.5000	16.6700	16.6000	15.8300	15.0500
Suma	123.1200	117.9800	140.1800	158.5100	156.1600	155.7400	143.4700	130.1700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.7392	0.3759	0.7512	1.7159	0.8995	0.4471	0.5839	0.8593

Descriptive statistics of L *								
Media	69.2600	67.6890	68.8650	70.6350	71.9360	72.4410	72.7240	71.1360
Error típico	0.2658	0.3555	0.4350	0.2342	0.2042	0.2450	0.1185	0.2137
Mediana	69.4000	67.5600	68.8450	70.5300	71.8350	72.6300	72.8050	71.1400
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.8405	1.1241	1.3755	0.7407	0.6458	0.7748	0.3749	0.6758
Varianza de la muestra	0.7064	1.2637	1.8919	0.5487	0.4170	0.6003	0.1405	0.4567
Curtosis	-1.4537	-0.4446	-0.9252	-0.1344	0.7006	-1.7748	1.1985	0.1699
Coeficiente de asimetría	-0.3567	0.1772	0.3452	0.1172	0.8025	-0.2755	-0.9780	0.6273
Rango	2.3600	3.7300	4.1200	2.5000	2.1900	2.0600	1.2900	2.2000
Mínimo	67.9400	65.8800	67.0700	69.3800	71.0800	71.3000	71.9200	70.2500
Máximo	70.3000	69.6100	71.1900	71.8800	73.2700	73.3600	73.2100	72.4500
Suma	692.6000	676.8900	688.6500	706.3500	719.3600	724.4100	727.2400	711.3600
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6012	0.8041	0.9839	0.5299	0.4619	0.5542	0.2682	0.4835

GTS PROTOCOL DYE

CENTRAL ZONE														
DYE A4	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	18.54	20.00		21.19	1		14.93	18.32	17.80	1	42.45	43.51		40.71
2		15.15	19.09	19.15	2	15.11	16.82	16.61		2	37.99	46.67	45.38	45.19
3	22.18	19.47	15.29	19.93	3	15.74	17.05	18.83	18.39	3	38.38	44.20	49.59	44.56
4	21.15	16.18	17.93		4	16.74	17.29	20.83	18.26	4	41.76	47.18	48.37	41.13
5	21.13	16.69	20.50	20.52	5	14.82	15.87	18.50	18.40	5	40.10	46.82	45.70	43.24
6	20.44	16.89	18.95	20.61	6	15.63	16.70	19.77	17.80	6	40.41	45.50	46.27	44.00
7	19.71	17.84	17.50	20.46	7	15.48	16.80	18.42	18.30	7	42.23	46.36	47.17	43.33
8	20.98	17.05	17.34	20.48	8	14.34	15.65	18.23	17.49	8	41.75	43.53	45.97	41.96
9	20.94	18.23	16.24	20.15	9	14.33	14.53	18.21	17.90	9	40.67	43.67	47.68	42.47
10	21.81	17.55	16.60	19.71	10	14.85	17.52	17.88	18.04	10	40.13	44.29	47.22	42.02
AVERAGE	20.76	17.51	17.72	20.24	AVERAGE	15.23	16.32	18.56	18.04	AVERAGE	40.59	45.17	47.04	42.86

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-1.51461	1.70478	2.37999	0.48142
x2	2.30868	-1.60912	0.23247	-1.16640
x3	0.54408	1.34265	-1.14137	-0.53635
x4	-0.03846	-0.90535	-0.18691	2.54119
x5	-0.04977	-0.55687	0.74223	-0.05977
x6	-0.44002	-0.42022	0.18185	0.01292
x7	-0.85289	0.22890	-0.34237	-0.10824
x8	-0.13461	-0.31089	-0.40022	-0.09208
x9	-0.15723	0.49538	-0.79791	-0.35864
x10	0.33482	0.03075	-0.66776	-0.71405

b	Z1	Z2	Z3	Z4
x1	2.23420	-1.36156	-0.21450	-0.18790
x2	-0.34834	0.49511	-1.74282	-2.36459
x3	0.19219	0.72106	0.24131	0.90974
x4	1.05018	0.95682	2.02882	0.66789
x5	-0.59716	-0.43813	-0.05363	0.92835
x6	0.09781	0.37723	1.08144	-0.18790
x7	-0.03089	0.47546	-0.12513	0.74231
x8	-1.00900	-0.65425	-0.29494	-0.76463
x9	-1.01758	-1.75450	-0.31281	-0.00186
x10	-0.57142	1.18277	-0.60775	0.25860

L	Z1	Z2	Z3	Z4
x1	1.21967	-1.11703	-2.23455	-1.47013
x2	-1.70021	1.00553	-0.54701	1.59179
x3	-1.44488	-0.65356	1.47132	1.16120
x4	0.76794	1.34809	0.88644	-1.18308
x5	-0.31883	1.10628	-0.39360	0.25903
x6	-0.11588	0.21964	-0.12033	0.77847
x7	1.07564	0.79730	0.31114	0.32054
x8	0.76139	-1.10359	-0.26416	-0.61580
x9	0.05434	-1.00956	0.55564	-0.26723
x10	-0.29919	-0.59311	0.33511	-0.57479

Descriptive statistics of a *				
Media	21.2180	17.5050	18.4470	20.5940
Error típico	0.5591	0.4628	0.8747	0.3915
Mediana	21.0550	17.3000	17.7150	20.4700
Desviación estándar	1.7681	1.4635	2.7660	1.2380
Varianza de la muestra	3.1262	2.1419	7.6506	1.5326
Curtosis	3.1554	-0.1331	3.2416	5.2563
Coeficiente de asimetría	1.1552	0.3226	1.5979	1.9956
Rango	6.7600	4.8500	9.7400	4.5900
Mínimo	18.5400	15.1500	15.2900	19.1500
Máximo	25.3000	20.0000	25.0300	23.7400
Suma	212.1800	175.0500	184.4700	205.9400
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.2648	1.0469	1.9787	0.8856

Descriptive statistics of b *				
Media	15.5160	16.3160	18.5600	17.9010
Error típico	0.3686	0.3219	0.3538	0.1700
Mediana	15.2950	16.7500	18.3700	17.9700
Desviación estándar	1.1655	1.0180	1.1189	0.5375
Varianza de la muestra	1.3584	1.0362	1.2519	0.2889
Curtosis	1.8791	-0.7753	1.7053	2.9813
Coeficiente de asimetría	1.3605	-0.7085	0.5616	-1.5839
Rango	3.7900	2.9900	4.2200	1.7700
Mínimo	14.3300	14.5300	16.6100	16.6300
Máximo	18.1200	17.5200	20.8300	18.4000
Suma	155.1600	163.1600	185.6000	179.0100
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8338	0.7282	0.8004	0.3845

Descriptive statistics of L*				
Media	40.5870	45.1730	46.5210	42.8610
Error típico	0.4830	0.4708	0.6596	0.4627
Mediana	40.5400	44.8950	46.7200	42.8550
Desviación estándar	1.5275	1.4888	2.0859	1.4631
Varianza de la muestra	2.3331	2.2164	4.3509	2.1408
Curtosis	-0.6358	-2.0226	2.3113	-0.9544
Coeficiente de asimetría	-0.5609	0.1505	-1.0113	0.1174
Rango	4.4600	3.6700	7.7300	4.4800
Mínimo	37.9900	43.5100	41.8600	40.7100
Máximo	42.4500	47.1800	49.5900	45.1900
Suma	405.8700	451.7300	465.2100	428.6100
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0927	1.0650	1.4921	1.0467

	PERIPHERAL ZONE							
	a							
DYE A4	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	21.83	17.87	16.09	18.66	25.65	25.23		18.38
2	21.57	16.99	16.61	16.29	20.91	25.51	18.72	20.68
3	23.76	17.11	15.57	15.86	24.96	24.88	19.49	18.47
4	25.61	17.42	15.85	16.05	21.00	22.44	19.01	18.14
5	21.15	17.33	15.27	15.84	24.86	23.40	18.89	19.24
6	21.4	18.02	15.8	15.84	25.37	25.26	18.93	19.07
7	21.21	18.46	16.48	16.35	24.58	25.21	18.92	19.32
8	23.17	20.42	15.86	15.91	21.91	23.21	18.78	19.14
9	21.93	21.39	16.37	16.11	24.49	24.66	18.65	19.28
10	24.99	20.54	15.66	18.43	24.89	24.21	18.67	20.09
AVERAGE	22.66	18.56	15.96	16.53	23.86	24.40	18.90	19.18

PERIPHERAL ZONE								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	18.3	21.23	19.1	20.35	19.52	21.41	19.58	16.30
2	20.11	18.69	19.23	20.44	20.02	21.82	16.99	17.28
3	14.82	21.62	16.58	19.46	22.36	21.10	19.40	16.01
4	21.13	22.16	17.67	21.16	24.02	21.72	21.05	17.06
5	23.26	20.39	17.06	17.16	22.88	20.78	18.52	14.19
6	22.66	22.97	15.52	17.79	21.35	19.87	18.96	16.57
7	20.11	22.28	15.37	17.89	20.48	20.30	19.10	15.10
8	15.92	21.4	16.21	17.12	22.71	21.01	19.59	16.81
9	21.61	18.91	14.86	18.28	22.46		19.07	16.92
10	18.25	19.18	17.87	21.08	19.94	20.23		17.27
AVERAGE	19.62	20.88	16.95	19.07	21.57	20.92	19.14	16.35

PERIPHERAL ZONE								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	42.31	44.03	48.87	49.83	46.10	47.36	46.38	45.59
2	41.97	46.95	50.53	48.8	51.33	46.54	44.91	41.07
3	39.69	46.82	50.31	50.22	46.77	46.38	45.79	45.32
4	38.77	47.26	49.22	50.24	50.06	49.03	47.04	44.54
5	42.53	46.73	47.65	48.47	49.24	49.02	47.12	42.91
6	41.55	47.18	48.14	49.21	48.73	47.16	46.54	44.07
7	44.3	47.49	49.31	49.88	48.32	48.02	46.24	42.90
8	39.35	46.37	48.45	49.02	48.76	48.91	45.47	42.79
9	36.55	45.29	47.72	49.99	47.98	47.42	45.15	44.51
10	44.91	44.13	48.03	49.9	47.30	49.45	43.78	43.28
AVERAGE	41.19	46.23	48.82	49.56	48.46	47.93	45.84	43.70

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.50969	-0.42350	0.31356	1.97498	0.97359	0.79008	2.24111	-1.03884
x2	-0.66897	-0.96755	1.53037	-0.22667	-1.60740	1.05694	-0.69763	1.94410
x3	0.67264	-0.89336	-0.90324	-0.62612	0.59787	0.45651	1.27005	-0.92212
x4	1.80597	-0.70171	-0.24804	-0.44962	-1.55839	-1.86894	0.04344	-1.35010
x5	-0.92626	-0.75735	-1.60525	-0.64470	0.54342	-0.95401	-0.26321	0.07652
x6	-0.77311	-0.33076	-0.36504	-0.64470	0.82112	0.81867	-0.16099	-0.14396
x7	-0.88951	-0.05873	1.22617	-0.17093	0.39096	0.77102	-0.18655	0.18027
x8	0.31120	1.15303	-0.22464	-0.57967	-1.06288	-1.13509	-0.54431	-0.05317
x9	-0.44843	1.75272	0.96876	-0.39388	0.34195	0.24684	-0.87651	0.12840
x10	1.42615	1.22722	-0.69264	1.76132	0.55976	-0.18203	-0.82540	1.17891

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.47372	0.22873	1.41652	0.79569	-1.34682	0.24399	0.51530	-0.05059
x2	0.17733	-1.44553	1.50205	0.85177	-1.01897	0.64899	-1.03298	0.92153
x3	-1.72547	0.48580	-0.24146	0.24114	0.51539	-0.06223	0.40769	-0.33826
x4	0.54422	0.84174	0.47568	1.30040	1.60386	0.55021	1.39405	0.70330
x5	1.31038	-0.32496	0.07435	-1.19198	0.85635	-0.37833	-0.11836	-2.14362
x6	1.09456	1.37566	-0.93886	-0.79943	-0.14688	-1.27723	0.14467	0.21724
x7	0.17733	0.92084	-1.03755	-0.73712	-0.71734	-0.85247	0.22836	-1.24094
x8	-1.32981	0.34078	-0.48489	-1.21691	0.74488	-0.15113	0.52127	0.45531
x9	0.71688	-1.30052	-1.37309	-0.49412	0.58096	2.19984	0.21042	0.56443
x10	-0.49171	-1.12255	0.60727	1.25055	-1.07142	-0.92162	-2.27041	0.91161

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.43146	-1.71051	0.04611	0.43606	-1.52310	-0.51030	0.51705	1.38149
x2	0.30013	0.56497	1.67483	-1.20315	1.85367	-1.24571	-0.89571	-1.91890
x3	-0.58056	0.46367	1.45898	1.05673	-1.09051	-1.38921	-0.04998	1.18435
x4	-0.93593	0.80655	0.38952	1.08856	1.03369	0.98742	1.15136	0.61481
x5	0.51644	0.39353	-1.15090	-1.72833	0.50426	0.97846	1.22824	-0.57538
x6	0.13790	0.74421	-0.67013	-0.55065	0.17497	-0.68967	0.67082	0.27163
x7	1.20014	0.98578	0.47782	0.51563	-0.08975	0.08161	0.38250	-0.58268
x8	-0.71189	0.11299	-0.36597	-0.85302	0.19434	0.87980	-0.35752	-0.66300
x9	-1.79345	-0.72862	-1.08222	0.69070	-0.30927	-0.45649	-0.66506	0.59290
x10	1.43576	-1.63258	-0.77806	0.54746	-0.74831	1.36410	-1.98172	-0.30521

Descriptive statistics of a *

Media	22.6620	18.5550	15.9560	16.5340	23.8620	24.4010	18.9930	19.1810
Error típico	0.5162	0.5115	0.1351	0.3404	0.5808	0.3318	0.1237	0.2438
Mediana	21.8800	17.9450	15.8550	16.0800	24.7200	24.7700	18.9050	19.1900
Moda	#N/A	#N/A	#N/A	15.8400	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.6324	1.6175	0.4273	1.0765	1.8365	1.0493	0.3913	0.7711
Varianza de la muestra	2.6646	2.6163	0.1826	1.1588	3.3728	1.1009	0.1531	0.5945
Curtosis	-0.6255	-0.9341	-0.8045	1.2303	-0.9448	-0.5902	2.0367	0.3375
Coeficiente de asimetría	0.9226	0.8687	0.1509	1.6698	-0.9740	-0.8436	1.6027	0.6424
Rango	4.4600	4.4000	1.3400	2.8200	4.7400	3.0700	1.2200	2.5400
Mínimo	21.1500	16.9900	15.2700	15.8400	20.9100	22.4400	18.6500	18.1400
Máximo	25.6100	21.3900	16.6100	18.6600	25.6500	25.5100	19.8700	20.6800
Suma	226.6200	185.5500	159.5600	165.3400	238.6200	244.0100	189.9300	191.8100
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.1677	1.1571	0.3057	0.7701	1.3138	0.7506	0.2799	0.5516

Descriptive statistics of b *

Media	19.6170	20.8830	16.9470	19.0730	21.5740	21.1630	18.7180	16.3510
Error típico	0.8791	0.4797	0.4806	0.5075	0.4823	0.3201	0.5290	0.3188
Mediana	20.1100	21.3150	16.8200	18.8700	21.8550	21.0550	19.0850	16.6900
Moda	20.1100	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.7801	1.5171	1.5199	1.6049	1.5251	1.0123	1.6728	1.0081
Varianza de la muestra	7.7290	2.3016	2.3102	2.5757	2.3258	1.0248	2.7984	1.0163
Curtosis	-0.6644	-1.3491	-1.0976	-1.8925	-1.3713	1.6896	2.5715	1.1832
Coeficiente de asimetría	-0.5016	-0.3503	0.2641	0.1059	0.0551	1.0495	-1.3511	-1.3372
Rango	8.4400	4.2800	4.3700	4.0400	4.5000	3.5200	6.1300	3.0900
Mínimo	14.8200	18.6900	14.8600	17.1200	19.5200	19.8700	14.9200	14.1900
Máximo	23.2600	22.9700	19.2300	21.1600	24.0200	23.3900	21.0500	17.2800
Suma	196.1700	208.8300	169.4700	190.7300	215.7400	211.6300	187.1800	163.5100
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9888	1.0853	1.0873	1.1481	1.0910	0.7242	1.1967	0.7212

Descriptive statistics of L *

Media	41.1930	46.2250	48.8230	49.5560	48.4590	47.9290	45.8420	43.6980
Error típico	0.8187	0.4058	0.3223	0.1987	0.4898	0.3526	0.3290	0.4331
Mediana	41.7600	46.7750	48.6600	49.8550	48.5250	47.7200	46.0150	43.6750
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.5889	1.2832	1.0192	0.6284	1.5488	1.1150	1.0405	1.3695
Varianza de la muestra	6.7022	1.6467	1.0388	0.3948	2.3988	1.2433	1.0827	1.8756
Curtosis	-0.4278	-0.4559	-0.8064	-1.1276	0.0551	-1.6332	0.1583	-0.0032
Coeficiente de asimetría	-0.3068	-1.0424	0.6054	-0.6262	0.3244	-0.0071	-0.6897	-0.4188
Rango	8.3600	3.4600	2.8800	1.7700	5.2300	3.0700	3.3400	4.5200
Mínimo	36.5500	44.0300	47.6500	48.4700	46.1000	46.3800	43.7800	41.0700
Máximo	44.9100	47.4900	50.5300	50.2400	51.3300	49.4500	47.1200	45.5900
Suma	411.9300	462.2500	488.2300	495.5600	484.5900	479.2900	458.4200	436.9800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.8520	0.9180	0.7291	0.4495	1.1080	0.7976	0.7443	0.9797

GTS PROTOCOL — BLEACHING

CENTRAL ZONE														
BLEACHING A7	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	4.75	4.36	5.21	9.13	1	19.78	18.33	16.49	19.97	1	76.30	74.74	73.69	66.97
2	5.37	5.90	9.11	5.01	2	16.43	15.63	16.34	19.20	2	73.64	72.61	63.55	76.42
3	5.44	4.74	7.80	8.08	3	16.36	19.64	16.75	19.98	3	74.03	74.03	65.62	69.00
4	5.18	5.17	7.19	7.13	4	17.22	19.43	16.65	20.59	4	74.60	73.44	66.22	70.58
5	5.04	5.54	6.54	6.55	5	17.87	18.62	15.40	19.46	5	74.98	73.54	67.74	72.62
6	4.48	5.27	5.53	6.73	6	20.04	18.93	15.75	18.09	6	76.53	73.57	73.08	74.70
7	4.48	5.39	5.60	5.20	7	18.92	18.07	13.53	19.31	7	77.32	73.44	74.31	75.62
8	4.94	5.56	8.23	5.97	8	18.12	17.77	16.07	18.63	8	76.09	73.03	65.53	75.23
9	5.25	5.22	5.10	6.02	9	16.80	17.62	14.84	18.27	9	75.85	74.04	74.98	74.99
10	5.24	5.81	5.26	6.37	10	17.09	16.16	14.43	18.78	10	75.55	72.21	74.91	74.05
AVERAGE	5.02	5.30	6.56	6.62	**AVERAGE**	17.86	18.02	15.63	19.23	**AVERAGE**	75.49	73.47	69.96	73.02

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-0.76771	-1.99827	-0.93068	2.00171
x2	1.01499	1.28948	1.76394	-1.28266
x3	1.21626	-1.18700	0.85882	1.16467
x4	0.46868	-0.26900	0.43736	0.40736
x5	0.06613	0.52092	-0.01175	-0.05501
x6	-1.54404	-0.05551	-0.70958	0.08849
x7	-1.54404	0.20068	-0.66122	-1.13119
x8	-0.22140	0.56361	1.15592	-0.51737
x9	0.66995	-0.16225	-1.00668	-0.47751
x10	0.64119	1.09734	-0.89613	-0.19850

b	Z1	Z2	Z3	Z4
x1	1.43546	0.23781	0.80962	0.92401
x2	-1.07304	-1.83344	0.66923	-0.03487
x3	-1.12546	1.24275	1.05298	0.93647
x4	-0.48148	1.08165	0.95938	1.69610
x5	0.00524	0.46028	-0.21060	0.28891
x6	1.63015	0.69809	0.11700	-1.41715
x7	0.79149	0.03836	-1.96088	0.10211
x8	0.19244	-0.19178	0.41651	-0.74469
x9	-0.79598	-0.30685	-0.73475	-1.19300
x10	-0.57883	-1.42686	-1.11850	-0.55789

L	Z1	Z2	Z3	Z4
x1	0.69696	1.74793	0.80959	-1.91420
x2	-1.58901	-1.17214	-1.39304	1.07674
x3	-1.25385	0.77457	-0.94339	-1.27170
x4	-0.76400	-0.03427	-0.81306	-0.77163
x5	-0.43743	0.10282	-0.48288	-0.12597
x6	0.89462	0.14395	0.67708	0.53235
x7	1.57354	-0.03427	0.94426	0.82354
x8	0.51649	-0.59635	-0.96294	0.70010
x9	0.31024	0.78828	1.08980	0.62414
x10	0.05242	-1.72051	1.07460	0.32663

Descriptive statistics of a *				
Media	5.0170	5.2960	6.5570	6.6190
Error típico	0.1100	0.1481	0.4577	0.3967
Mediana	5.1100	5.3300	6.0700	6.4600
Moda	4.4800	#N/A	#N/A	#N/A
Desviación estándar	0.3478	0.4684	1.4473	1.2544
Varianza de la muestra	0.1210	0.2194	2.0948	1.5736
Curtosis	-0.9813	0.5336	-1.0842	0.5478
Coeficiente de asimetría	-0.5991	-0.8169	0.6330	0.8133
Rango	0.9600	1.5400	4.0100	4.1200
Mínimo	4.4800	4.3600	5.1000	5.0100
Máximo	5.4400	5.9000	9.1100	9.1300
Suma	50.1700	52.9600	65.5700	66.1900
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.2488	0.3351	1.0354	0.8974

Descriptive statistics of b *				
Media	17.8630	18.0200	15.6250	19.2280
Error típico	0.4223	0.4122	0.3379	0.2539
Mediana	17.5450	18.2000	15.9100	19.2550
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3355	1.3036	1.0684	0.8030
Varianza de la muestra	1.7834	1.6993	1.1415	0.6448
Curtosis	-1.0220	-0.0845	-0.1095	-0.7939
Coeficiente de asimetría	0.6003	-0.7594	-0.8875	0.1922
Rango	3.6800	4.0100	3.2200	2.5000
Mínimo	16.3600	15.6300	13.5300	18.0900
Máximo	20.0400	19.6400	16.7500	20.5900
Suma	178.6300	180.2000	156.2500	192.2800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9553	0.9325	0.7643	0.5744

Descriptive statistics of L *				
Media	75.4890	73.4650	69.9630	73.0180
Error típico	0.3680	0.2307	1.4558	0.9991
Mediana	75.7000	73.4900	70.4100	74.3750
Moda	#N/A	73.4400	#N/A	#N/A
Desviación estándar	1.1636	0.7294	4.6036	3.1595
Varianza de la muestra	1.3540	0.5321	21.1930	9.9828
Curtosis	-0.7791	0.2131	-2.1376	-0.2614
Coeficiente de asimetría	-0.1937	-0.0856	-0.1205	-0.9657
Rango	3.6800	2.5300	11.4300	9.4500
Mínimo	73.6400	72.2100	63.5500	66.9700
Máximo	77.3200	74.7400	74.9800	76.4200
Suma	754.8900	734.6500	699.6300	730.1800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8324	0.5218	3.2932	2.2602

BLEACHING A7	PERIPHERAL ZONE							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	5.52	6.24	7.27	6.29	10.63	10.28	9.35	5.93
2	7.48	6.4	6.38	8.46	9.53	11.94	5.83	7.12
3	7.66	6.9	6.24	7.81	11.13	11.36	6.54	6.52
4	7.6	7.37	6.52	7.82	9.86	10.34	6.34	6.66
5	7.51	6.31	6.7	8.68	9.66	10.13	7.24	6.42
6	5.95	6.83	7.28	8.2	8.75	9.50	7.38	6.26
7	6.98	6.94	7.02	7.94	8.53	8.82	7.22	6.63
8	6.11	7.2	7.34	7.04	8.23	9.60	6.84	6.26
9	6.4	7.41	7.05	8.16	8.18	10.29	8.00	5.71
10	6.58	8.17	6.88	7.03	9.03	10.21	8.37	5.56
AVERAGE	6.78	6.98	6.87	7.74	9.35	10.25	7.31	6.31

PERIPHERAL ZONE								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	16.03	15.47	17.03	18.17	18.55	21.18	18.71	18.68
2	23.8	15.47	18.78	17.76	20.73	22.67	19.18	
3	20.93	23.23	18.75	17.35	23.40	22.64	18.74	18.51
4	20.02	20.6	17.81	16.86	23.39	23.31	19.71	17.93
5	18.47	17.32	17.3	15.05	21.34	22.56	19.13	18.76
6	15.4	20.31	16.43	17.04	20.60	22.03	19.17	18.57
7	15.61	15.78	18.06	15.26	19.49	21.23	19.71	17.77
8	15.81	17.17	16.76	15.86	19.50	20.81	20.78	18.72
9	16.23	18.48	17.03	16.25	20.23	21.39	19.79	19.63
10	17.49	20.14	17.31	17.6	20.03	22.93	20.26	19.99
AVERAGE	17.98	18.40	17.53	16.72	20.73	22.08	19.52	18.73

PERIPHERAL ZONE								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	73.1	72.03	71.51	74.84	60.78	65.30	69.41	74.27
2	70.56	71.53	75.33	71.65	64.00	70.80	74.81	69.87
3	69.74	70.85	75.48	73.19	69.91	70.82	73.36	70.17
4	70.35	70.32	75.36	73.85	70.34	71.03	73.61	70.78
5	69.71	71.53	75.28	74.45	68.94	70.41	73.00	71.13
6	72.01	69.87	74.35	74.15	68.34	70.54	72.63	71.91
7	70.42	70.2	74.05	74.65	67.24	70.52	73.09	72.24
8	72.44	69.56	74.12	74.95	67.89	69.63	72.55	72.47
9	71.41	68.26	73.47	75.23	67.54	68.32	71.22	73.74
10	71.13	68.06	72.61	72.38	65.72	66.47	70.42	74.41
AVERAGE	71.09	70.22	74.16	73.93	67.07	69.38	72.41	72.10

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	-1.62244	-1.24284	1.02205	-1.96164	1.28032	0.03704	1.96160	-0.79794
x2	0.90336	-0.97302	-1.24070	0.96800	0.17746	1.90015	-1.42478	1.72076
x3	1.13532	-0.12985	-1.59663	0.09045	1.78162	1.24919	-0.74173	0.45083
x4	1.05800	0.66274	-0.88476	0.10395	0.50832	0.10438	-0.93414	0.74715
x5	0.94202	-1.12479	-0.42712	1.26501	0.30780	-0.13132	-0.06830	0.23917
x6	-1.06831	-0.24789	1.04747	0.61698	-0.60457	-0.83840	0.06638	-0.09948
x7	0.25902	-0.06239	0.38645	0.26596	-0.82514	-1.60161	-0.08755	0.68365
x8	-0.86212	0.37606	1.20002	-0.94909	-1.12592	-0.72617	-0.45312	-0.09948
x9	-0.48841	0.73019	0.46272	0.56298	-1.17605	0.04826	0.66284	-1.26359
x10	-0.25645	2.01181	0.03051	-0.96259	-0.32384	-0.04153	1.01880	-1.58107

b	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	-0.69360	-1.11913	-0.61710	1.35158	-1.35717	-1.03336	-1.22198	0.20462
x2	2.07154	-1.11913	1.56017	0.96941	0.00249	0.68698	-0.51117	-2.24528
x3	1.05019	1.84788	1.52285	0.58724	1.66777	0.65235	-1.17661	0.04863
x4	0.72634	0.84231	0.35334	0.13050	1.66153	1.42592	0.29037	-0.48356
x5	0.17473	-0.41179	-0.28118	-1.55665	0.38295	0.55998	-0.58679	0.27802
x6	-0.91780	0.73143	-1.36359	0.29828	-0.07859	-0.05196	-0.52630	0.10368
x7	-0.84307	-1.00060	0.66438	-1.36090	-0.77089	-0.97563	0.29037	-0.63037
x8	-0.77189	-0.46914	-0.95302	-0.80163	-0.76465	-1.46056	1.90858	0.24132
x9	-0.62242	0.03173	-0.61710	-0.43810	-0.30935	-0.79090	0.41136	1.07630
x10	-0.17402	0.66643	-0.26874	0.82027	-0.43409	0.98718	1.12216	1.40663

L	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	1.75674	1.34914	-1.99978	0.76722	-2.17023	-2.01916	-1.86222	1.32100
x2	-0.45991	0.97625	0.88728	-1.93414	-1.05924	0.70008	1.48978	-1.35629
x3	-1.17552	0.46911	1.00065	-0.63004	0.97988	0.70997	0.58970	-1.17375
x4	-0.64318	0.07383	0.90995	-0.07113	1.12824	0.81379	0.74489	-0.80258
x5	-1.20170	0.97625	0.84949	0.43696	0.64520	0.50726	0.36624	-0.58961
x6	0.80550	-0.26177	0.14662	0.18291	0.43819	0.57154	0.13656	-0.11500
x7	-0.58209	-0.01566	-0.08011	0.60632	0.05865	0.56165	0.42210	0.08580
x8	1.18076	-0.49297	-0.02721	0.86037	0.28292	0.12162	0.08690	0.22574
x9	0.28188	-1.46251	-0.51846	1.09748	0.16216	-0.52605	-0.73868	0.99851
x10	0.03753	-1.61167	-1.16843	-1.31596	-0.46579	-1.44070	-1.23528	1.40619

Descriptive statistics of a *

Media	6.7790	6.9770	6.8680	7.7430	9.3530	10.2470	7.3110	6.3070
Error típico	0.2454	0.1875	0.1244	0.2342	0.3154	0.2818	0.3287	0.1494
Mediana	6.7800	6.9200	6.9500	7.8800	9.2800	10.2450	7.2300	6.3400
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.2600
Desviación estándar	0.7760	0.5930	0.3933	0.7407	0.9974	0.8910	1.0395	0.4725
Varianza de la muestra	0.6022	0.3516	0.1547	0.5486	0.9948	0.7938	1.0805	0.2232
Curtosis	-1.4545	0.4112	-1.2944	0.0622	-0.6361	0.6421	0.3103	-0.2915
Coeficiente de asimetría	-0.2814	0.6381	-0.3679	-0.8236	0.5624	0.5178	0.6510	-0.0754
Rango	2.1400	1.9300	1.1000	2.3900	2.9500	3.1200	3.5200	1.5600
Mínimo	5.5200	6.2400	6.2400	6.2900	8.1800	8.8200	5.8300	5.5600
Máximo	7.6600	8.1700	7.3400	8.6800	11.1300	11.9400	9.3500	7.1200
Suma	67.7900	69.7700	68.6800	77.4300	93.5300	102.4700	73.1100	63.0700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.5551	0.4242	0.2814	0.5299	0.7135	0.6374	0.7436	0.3380

Descriptive statistics of b *

Media	17.9790	18.3970	17.5260	16.7200	20.7260	22.0750	19.5180	18.4570
Error típico	0.8886	0.8271	0.2542	0.3393	0.5070	0.2739	0.2091	0.3446
Mediana	16.8600	17.9000	17.3050	16.9500	20.4150	22.2950	19.4450	18.6250
Moda	#N/A	15.4700	17.0300	#N/A	#N/A	#N/A	19.7100	#N/A
Desviación estándar	2.8100	2.6154	0.8038	1.0728	1.6033	0.8661	0.6612	1.0898
Varianza de la muestra	7.8960	6.8405	0.6460	1.1509	2.5707	0.7501	0.4372	1.1878
Curtosis	0.4324	-0.6588	-0.8260	-1.1633	-0.0808	-1.5949	-0.1253	2.4037
Coeficiente de asimetría	1.1145	0.5023	0.5214	-0.3790	0.8007	-0.1394	0.6318	-1.0566
Rango	8.4000	7.7600	2.3500	3.1200	4.8500	2.5000	2.0700	3.9800
Mínimo	15.4000	15.4700	16.4300	15.0500	18.5500	20.8100	18.7100	16.0100
Máximo	23.8000	23.2300	18.7800	18.1700	23.4000	23.3100	20.7800	19.9900
Suma	179.7900	183.9700	175.2600	167.2000	207.2600	220.7500	195.1800	184.5700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.0101	1.8710	0.5750	0.7674	1.1470	0.6196	0.4730	0.7796

Descriptive statistics of L*

Media	71.0870	70.2210	74.1560	73.9340	67.0700	69.3840	72.4100	72.0990
Error típico	0.3624	0.4240	0.4184	0.3734	0.9165	0.6396	0.5094	0.5197
Mediana	70.8450	70.2600	74.2350	74.3000	67.7150	70.4650	72.8150	72.0750
Desviación estándar	1.1459	1.3408	1.3231	1.1809	2.8983	2.0226	1.6110	1.6434
Varianza de la muestra	1.3130	1.7979	1.7507	1.3945	8.4002	4.0910	2.5952	2.7009
Curtosis	-0.7990	-0.7242	0.1913	-0.0465	1.3896	0.5086	0.0383	-1.3340
Coeficiente de asimetría	0.5128	-0.4211	-0.9253	-0.9781	-1.2159	-1.3378	-0.6519	0.1747
Rango	3.3900	3.9700	3.9700	3.5800	9.5600	5.7300	5.4000	4.5400
Mínimo	69.7100	68.0600	71.5100	71.6500	60.7800	65.3000	69.4100	69.8700
Máximo	73.1000	72.0300	75.4800	75.2300	70.3400	71.0300	74.8100	74.4100
Suma	710.8700	702.2100	741.5600	739.3400	670.7000	693.8400	724.1000	720.9900
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8197	0.9592	0.9465	0.8448	2.0733	1.4469	1.1524	1.1757

ADA PROTOCOL ***POLISH***

CENTRAL ZONE														
POLISH B5	0				b					0				
	Z1	**Z2**	**Z3**	**Z4**		**Z1**	**Z2**	**Z3**	**Z4**		**Z1**	**Z2**	**Z3**	**Z4**
1	7.23	8.30	8.88	8.45	1	11.33	11.52	8.67	8.92	1	65.27	65.38	62.99	63.11
2	8.88	6.17	8.78	9.74	2	10.99	17.46	10.81	8.56	2	65.69	67.02	64.53	62.00
3	6.10	6.72	8.92	9.86	3	17.40	18.28	9.01	9.07	3	65.74	65.84	63.86	61.45
4	6.75	9.02	9.31	9.60	4	17.01	11.38	9.09	9.33	4	64.48	65.71	63.32	63.61
5	5.69	8.00	8.66	8.71	5	19.70	12.45	9.42	7.88	5	66.14	64.69	63.68	64.69
6	6.33	7.58	9.70	9.37	6	17.99	14.44	7.32	7.88	6	65.61	64.69	63.79	62.99
7	7.46	6.76	9.14	9.71	7	16.20	16.22	8.01	9.42	7	64.69	65.01	62.72	61.88
8	7.31	6.67	9.09	9.25	8	15.49	15.85	8.54	10.74	8	63.21	65.51	63.11	62.38
9	6.35	5.92	8.51	8.99	9	17.35	19.06	9.56	10.85	9	63.85	67.52	65.35	61.55
10	8.04	6.11	9.39	9.27	10	14.76	19.32	8.41	9.60	10	63.75	66.78	63.21	62.07
AVERAGE	7.01	7.13	9.04	9.30	**AVERAGE**	15.82	15.60	8.88	9.23	**AVERAGE**	64.84	65.82	63.66	62.57

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	0.22312	1.12357	-0.43703	-1.82000
x2	1.92752	-0.91320	-0.71363	0.95846
x3	-0.94414	-0.38727	-0.32639	1.21692
x4	-0.27270	1.81205	0.75235	0.65692
x5	-1.36765	0.83670	-1.04555	-1.26000
x6	-0.70655	0.43508	1.83109	0.16154
x7	0.46070	-0.34902	0.28213	0.89385
x8	0.30576	-0.43508	0.14383	-0.09692
x9	-0.68589	-1.15225	-1.46044	-0.65692
x10	1.05983	-0.97057	0.97363	-0.05385

b	Z1	Z2	Z3	Z4
x1	-1.60063	-1.34593	-0.22543	-0.29999
x2	-1.72178	0.61455	2.02883	-0.65409
x3	0.56229	0.88518	0.13273	-0.15246
x4	0.42332	-1.39213	0.21700	0.10328
x5	1.38185	-1.03898	0.56462	-1.32293
x6	0.77252	-0.38219	-1.64750	-1.32293
x7	0.13469	0.20529	-0.92066	0.19180
x8	-0.11830	0.08317	-0.36237	1.49014
x9	0.54447	1.14262	0.71209	1.59833
x10	-0.37842	1.22843	-0.49931	0.36885

L	Z1	Z2	Z3	Z4
x1	0.42754	-0.44083	-0.84256	0.52473
x2	0.84806	1.22115	1.10571	-0.55991
x3	0.89813	0.02534	0.25808	-1.09734
x4	-0.36346	-0.10641	-0.42508	1.01331
x5	1.29863	-1.14008	0.03036	2.06863
x6	0.76796	-1.14008	0.16952	0.40747
x7	-0.15319	-0.81579	-1.18414	-0.67717
x8	-1.63505	-0.30909	-0.69075	-0.18859
x9	-0.99425	1.72786	2.14309	-0.99963
x10	-1.09437	0.97794	-0.56424	-0.49151

Descriptive statistics of a *

Media	7.0140	7.1250	9.0380	9.2950
Error típico	0.3061	0.3307	0.1143	0.1468
Mediana	6.9900	6.7400	9.0050	9.3200
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.9681	1.0458	0.3615	0.4643
Varianza de la muestra	0.9372	1.0937	0.1307	0.2156
Curtosis	0.0020	-0.7774	-0.2974	-0.5109
Coeficiente de asimetría	0.6103	0.6455	0.3853	-0.6429
Rango	3.1900	3.1000	1.1900	1.4100
Mínimo	5.6900	5.9200	8.5100	8.4500
Máximo	8.8800	9.0200	9.7000	9.8600
Suma	70.1400	71.2500	90.3800	92.9500
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6925	0.7481	0.2586	0.3321

Descriptive statistics of b

Media	15.8220	15.5980	8.8840	9.2250
Error típico	0.8875	0.9581	0.3002	0.3215
Mediana	16.6050	16.0350	8.8400	9.2000
Moda	#N/A	#N/A	#N/A	7.8800
Desviación estándar	2.8064	3.0299	0.9493	1.0167
Varianza de la muestra	7.8758	9.1802	0.9012	1.0336
Curtosis	-0.0624	-1.5098	1.2200	-0.4556
Coeficiente de asimetría	-0.7978	-0.2824	0.4818	0.3485
Rango	8.7100	7.9400	3.4900	2.9700
Mínimo	10.9900	11.3800	7.3200	7.8800
Máximo	19.7000	19.3200	10.8100	10.8500
Suma	158.2200	155.9800	88.8400	92.2500
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.0076	2.1674	0.6791	0.7273

Descriptive statistics of L

Media	64.8430	65.8150	63.6560	62.5730
Error típico	0.3158	0.3120	0.2500	0.3236
Mediana	64.9800	65.6100	63.5000	62.2250
Moda	#N/A	64.6900	#N/A	#N/A
Desviación estándar	0.9987	0.9868	0.7904	1.0234
Varianza de la muestra	0.9975	0.9737	0.6248	1.0473
Curtosis	-1.2903	-0.8646	1.2101	0.5248
Coeficiente de asimetría	-0.3695	0.5961	1.1628	0.9962
Rango	2.9300	2.8300	2.6300	3.2400
Mínimo	63.2100	64.6900	62.7200	61.4500
Máximo	66.1400	67.5200	65.3500	64.6900
Suma	648.4300	658.1500	636.5600	625.7300
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.7145	0.7059	0.5655	0.7321

POLISH B5	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	7.42	11.68	7.28	10.53	10.34	10.07	11.50	9.32
2	10.23	10.58	7.69	8.9	9.66	10.26	9.52	8.65
3	10.87	10.16	8.16	9.97	11.47	11.88	11.09	8.32
4	7.02	7.08	10.04	11.28	11.93	11.72	9.51	8.22
5	8.76	8.3	9.29	9.72	11.07	10.21	10.70	7.29
6	9.95	9.27	9.65	9.92	10.65	9.58	10.52	7.41
7	11.03	9.5	10.31	10.7	10.38	10.83	10.70	8.82
8	10.44	9.58	8.19	9.69	10.11	11.81	10.73	8.93
9	9.5	8.86	8.9	9.34	10.72	11.19	10.92	10.35
10	10.09	11.4	11.42	10.76	11.00	10.33	11.49	9.34
AVERAGE	9.53	9.64	9.09	10.08	10.73	10.79	10.67	8.67

	PZ							
	b							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	14.98	8.12	17.32	8.06	8.79	9.39	9.07	12.41
2	10.52	8.91	17.32	9.6	9.10	9.44	10.77	15.26
3	11.64	11.85	16.23	7.81		11.88	10.16	14.19
4	15.96	14.53	9.67	5.07	10.05	11.83	10.23	14.74
5	10.97	15.72	11.25	7.4	10.93	9.72	9.05	17.13
6	8.44	13.72	11.03	6.75	10.46	10.37	8.50	16.17
7	8.11	12.14	12.1	6.91	10.02	10.81	8.98	16.03
8	8.44	13.91	15.2	7.76	9.69	11.69	9.05	16.22
9	9.34	13.79	13.53	8.74	10.34	10.24	9.27	13.20
10	8.63	10.86	16.8	5.41	9.48	10.22	7.49	13.94
AVERAGE	10.70	12.36	14.05	7.35	9.87	10.56	9.26	14.93

	PZ							
	L							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	64.19	64.21	66.07	62.38	61.02	63.41	60.14	60.23
2	62.21	64.31	64.07	62.56	63.21	62.37	62.58	62.77
3	61.4	63.73	65.91	62.11	64.61	60.21	60.95	61.79
4		64.78	61.97	61.74	62.92	61.06	62.80	61.99
5	63.41	67.11	66.21	62.21	62.91	64.44	57.52	64.30
6	61.33	67.24	65.69	62.2	64.69	64.09	59.89	62.98
7	61.03	68.11	63.04	61.47	65.39	62.92	58.76	61.90
8	60.55	66.87	65.23	64.2	65.38	63.02	59.79	62.22
9	64.42	63.91	60.69	63.47	63.30	62.39	59.51	61.09
10	61.05	64.33		62.2	64.52	62.69	56.95	58.81
AVERAGE	62.18	65.46	64.32	62.45	63.80	62.66	59.89	61.81

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-1.52704	1.46095	-1.39874	0.61813	-0.59050	-0.87454	1.20422	0.71273
x2	0.50564	0.67280	-1.08242	-1.62586	-1.61224	-0.64312	-1.66159	-0.01632
x3	0.96859	0.37187	-0.71982	-0.15281	1.10738	1.33009	0.61079	-0.37541
x4	-1.81638	-1.83497	0.73062	1.65064	1.79856	1.13520	-1.67606	-0.48422
x5	-0.55772	-0.96083	0.15199	-0.49698	0.50636	-0.70402	0.04632	-1.49619
x6	0.30309	-0.26582	0.42973	-0.22165	-0.12471	-1.47138	-0.21421	-1.36561
x7	1.08433	-0.10103	0.93892	0.85217	-0.53040	0.05116	0.04632	0.16866
x8	0.65754	-0.04371	-0.69667	-0.53828	-0.93609	1.24482	0.08974	0.28836
x9	-0.02242	-0.55959	-0.14890	-1.02012	-0.01953	0.48965	0.36474	1.83351
x10	0.40436	1.26033	1.79530	0.93477	0.40118	-0.55786	1.18974	0.73449

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	1.53324	-1.71730	1.13268	0.50996	-1.19607	-1.21894	-0.19904	-1.67860
x2	-0.06560	-1.39696	1.13268	1.61763	-0.92932	-1.16680	1.61040	0.22057
x3	0.33590	-0.20478	0.75569	0.33014	2.37492	1.37743	0.96113	-0.49245
x4	1.88456	0.88197	-1.51312	-1.64065	-0.11186	1.32529	1.03564	-0.12595
x5	0.09572	1.36452	-0.96667	0.03524	0.64536	-0.87484	-0.22033	1.46669
x6	-0.81125	0.55351	-1.04276	-0.43228	0.24093	-0.19707	-0.80573	0.82697
x7	-0.92955	-0.08718	-0.67269	-0.31720	-0.13768	0.26172	-0.29483	0.73368
x8	-0.81125	0.63056	0.39946	0.29418	-0.42163	1.17931	-0.22033	0.86029
x9	-0.48862	0.58190	-0.17812	0.99906	0.13768	-0.33263	0.01384	-1.15216
x10	-0.74314	-0.60623	0.95283	-1.39610	-0.60234	-0.35348	-1.88076	-0.65905

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.67535	-0.75118	0.27166	-0.09153	-2.02604	0.58698	0.13192	-1.04014
x2	-0.22999	-0.69109	-0.33472	0.13111	-0.42711	-0.22696	1.41431	0.63410
x3	-0.60036	-1.03964	0.22315	-0.42550	0.59504	-1.91746	0.55763	-0.01186
x4	2.20712	-0.40864	-0.97142	-0.88316	-0.63884	-1.25222	1.52994	0.11997
x5	0.31870	0.99156	0.31411	-0.30181	-0.64614	1.39309	-1.24508	1.64261
x6	-0.63237	1.06969	0.15645	-0.31418	0.65344	1.11917	0.00053	0.77253
x7	-0.76954	1.59251	-0.64701	-1.21713	1.16452	0.20349	-0.59337	0.06064
x8	-0.98902	0.84734	0.01698	2.15967	1.15722	0.28175	-0.05203	0.27157
x9	0.78052	-0.93147	-1.35951	1.25671	-0.36140	-0.21131	-0.19919	-0.47327
x10	-0.76040	-0.67907	2.33032	-0.31418	0.52933	0.02348	-1.54465	-1.97614

Descriptive statistics of a *

Media	9.5310	9.6410	9.0930	10.0810	10.7330	10.7880	10.6680	8.6650
Error típico	0.4372	0.4413	0.4099	0.2297	0.2105	0.2596	0.2185	0.2906
Mediana	10.0200	9.5400	9.0950	9.9450	10.6850	10.5800	10.7150	8.7350
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	10.7000	#N/A
Desviación estándar	1.3824	1.3957	1.2962	0.7264	0.6655	0.8210	0.6909	0.9190
Varianza de la muestra	1.9111	1.9479	1.6800	0.5276	0.4429	0.6740	0.4774	0.8446
Curtosis	-0.1991	-0.0625	-0.5875	-0.6117	-0.0212	-1.4944	-0.0223	0.1180
Coeficiente de asimetría	-0.9772	-0.2479	0.3289	0.0717	0.2781	0.1694	-0.7775	0.1234
Rango	4.0100	4.6000	4.1400	2.3800	2.2700	2.3000	1.9900	3.0600
Mínimo	7.0200	7.0800	7.2800	8.9000	9.6600	9.5800	9.5100	7.2900
Máximo	11.0300	11.6800	11.4200	11.2800	11.9300	11.8800	11.5000	10.3500
Suma	95.3100	96.4100	90.9300	100.8100	107.3300	107.8800	106.6800	86.6500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9889	0.9984	0.9272	0.5196	0.4761	0.5873	0.4942	0.6574

Descriptive statistics of b *

Media	10.7030	12.3550	14.0450	7.3510	10.1800	10.5590	9.2570	14.9290
Error típico	0.8821	0.7798	0.9143	0.4397	0.3675	0.3033	0.2971	0.4745
Mediana	9.9300	12.9300	14.3650	7.5800	10.0350	10.3050	9.0600	15.0000
Moda	8.4400	#N/A	17.3200	#N/A	#N/A	#N/A	9.0500	#N/A
Desviación estándar	2.7895	2.4661	2.8914	1.3903	1.1621	0.9590	0.9395	1.5007
Varianza de la muestra	7.7814	6.0815	8.3601	1.9329	1.3506	0.9197	0.8827	2.2520
Curtosis	0.0536	-0.6113	-1.7266	-0.1881	3.2878	-1.4365	0.3918	-0.8724
Coeficiente de asimetría	1.1025	-0.5804	-0.2146	-0.2536	1.5096	0.3391	-0.1466	-0.2644
Rango	7.8500	7.6000	7.6500	4.5300	4.1500	2.4900	3.2800	4.7200
Mínimo	8.1100	8.1200	9.6700	5.0700	8.7900	9.3900	7.4900	12.4100
Máximo	15.9600	15.7200	17.3200	9.6000	12.9400	11.8800	10.7700	17.1300
Suma	107.0300	123.5500	140.4500	73.5100	101.8000	105.5900	92.5700	149.2900
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9955	1.7641	2.0684	0.9946	0.8313	0.6861	0.6721	1.0735

Descriptive statistics of L *

Media	62.7130	65.4600	65.1740	62.4540	63.7950	62.6600	59.8890	61.8080
Error típico	0.6916	0.5262	1.0430	0.2557	0.4331	0.4041	0.6017	0.4797
Mediana	61.8050	64.5550	65.4600	62.2050	63.9100	62.8050	59.8400	61.9450
Moda	#N/A	#N/A	#N/A	62.2000	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.1870	1.6640	3.2983	0.8085	1.3697	1.2777	1.9027	1.5171
Varianza de la muestra	4.7830	2.7690	10.8785	0.6536	1.8760	1.6326	3.6202	2.3016
Curtosis	1.3908	-1.7352	3.0818	1.5781	0.3007	0.3408	-0.4547	0.9586
Coeficiente de asimetría	1.2810	0.5248	1.2476	1.3057	-0.7230	-0.6522	0.1046	-0.5248
Rango	6.9900	4.3800	12.1700	2.7300	4.3700	4.2300	5.8500	5.4900
Mínimo	60.5500	63.7300	60.6900	61.4700	61.0200	60.2100	56.9500	58.8100
Máximo	67.5400	68.1100	72.8600	64.2000	65.3900	64.4400	62.8000	64.3000
Suma	627.1300	654.6000	651.7400	624.5400	637.9500	626.6000	598.8900	618.0800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.5645	1.1904	2.3594	0.5783	0.9798	0.9140	1.3611	1.0853

ADA PROTOCOL DYE

CENTRAL ZONE														
DYE B4	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	7.67	7.25	8.49	5.69	1	7.21	7.34	4.73	7.74	1	47.64	46.53	47.65	51.52
2	6.64	6.04	11.19	7.83	2	5.57	7.12	5.84	8.25	2	48.78	48.67	37.86	48.14
3	9.13	6.72	8.62	8.24	3	6.34	6.61	7.92	6.04	3		45.50	47.51	46.12
4	5.54		8.36	6.37	4		6.58	9.39	8.02	4	51.08		45.99	50.74
5	6.64	7.59	7.77	6.43	5	7.05	6.23	8.68		5	49.61	45.21	48.76	52.02
6	6.93	6.67	6.95	7.17	6	6.29	5.98	6.97	8.23	6	49.21	48.59	52.45	51.59
7	7.03	6.67	6.16	7.69	7	6.24	5.91	8.31	6.96	7	48.74	48.51	50.85	47.49
8	7.56	6.34	9.14	6.95	8	5.74	6.41	7.39	8.13	8	48.00	48.37	44.57	49.13
9	7.11	7.48	8.75	6.94	9	6.13		6.91	7.42	9	47.90	47.66	45.16	51.45
10	6.15	6.59	9.69	6.53	10	7.28	6.18	7.17	7.56	10	50.56	47.49	41.44	51.88
AVERAGE	7.04	6.82	8.51	6.98	AVERAGE	6.43	6.48	7.33	7.59	AVERAGE	49.06	47.39	46.22	50.01

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	0.65155	0.09478	-0.01575	-1.67150
x2	-0.41368	-0.96711	1.91678	1.09280
x3	2.16148	-0.37034	0.07730	1.62241
x4	-1.55130	2.56959	-0.10879	-0.79312
x5	-0.41368	0.39316	-0.53109	-0.71562
x6	-0.11376	-0.41422	-1.11800	0.24026
x7	-0.01034	-0.41422	-1.68344	0.91196
x8	0.53778	-0.70383	0.44949	-0.04392
x9	0.07239	0.29663	0.17035	-0.05684
x10	-0.92044	-0.48443	0.84315	-0.58645

B	Z1	Z2	Z3	Z4
x1	0.60954	1.37977	-1.91001	-0.12971
x2	-1.17874	1.08957	-1.09489	0.31132
x3	-0.33912	0.41683	0.43252	-1.59982
x4	2.19065	0.37726	1.51200	0.11242
x5	0.43508	-0.08442	0.99062	2.30028
x6	-0.39364	-0.41419	-0.26510	0.29402
x7	-0.44816	-0.50653	0.71891	-0.80423
x8	-0.99337	0.15301	0.04333	0.20754
x9	-0.56811	-2.26092	-0.30916	-0.40644
x10	0.68587	-0.15038	-0.11823	-0.28537

L	Z1	Z2	Z3	Z4
x1	-0.42988	-0.09348	0.33099	0.71124
x2	0.12828	0.80361	-1.94140	-0.87870
x3	-2.37852	-0.52526	0.29850	-1.82890
x4	1.25438	-2.41167	-0.05431	0.34433
x5	0.53465	-0.64683	0.58864	0.94644
x6	0.33881	0.77008	1.44514	0.74417
x7	0.10869	0.73654	1.07376	-1.18446
x8	-0.25362	0.67785	-0.38392	-0.41301
x9	-0.30258	0.38022	-0.24697	0.67831
x10	0.99978	0.30895	-1.11043	0.88058

Descriptive statistics of a *				
Media	7.0400	7.1420	8.5120	6.9840
Error típico	0.3058	0.3603	0.4418	0.2448
Mediana	6.9800	6.6950	8.5550	6.9450
Moda	6.6400	6.6700	#N/A	#N/A
Desviación estándar	0.9669	1.1395	1.3971	0.7742
Varianza de la muestra	0.9350	1.2984	1.9520	0.5993
Curtosis	1.9157	5.4563	0.8375	-0.4910
Coeficiente de asimetría	0.8159	2.1520	0.1970	0.0848
Rango	3.5900	4.0300	5.0300	2.5500
Mínimo	5.5400	6.0400	6.1600	5.6900
Máximo	9.1300	10.0700	11.1900	8.2400
Suma	70.4000	71.4200	85.1200	69.8400
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6917	0.8151	0.9995	0.5538

Descriptive statistics of b *				
Media	6.6510	6.2940	7.3310	7.8900
Error típico	0.2900	0.2397	0.4306	0.3657
Mediana	6.3150	6.3200	7.2800	7.8800
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.9171	0.7581	1.3618	1.1564
Varianza de la muestra	0.8410	0.5747	1.8544	1.3372
Curtosis	1.4469	2.4943	0.2990	3.3039
Coeficiente de asimetría	1.1324	-1.0712	-0.4790	1.0458
Rango	3.0900	2.7600	4.6600	4.5100
Mínimo	5.5700	4.5800	4.7300	6.0400
Máximo	8.6600	7.3400	9.3900	10.5500
Suma	66.5100	62.9400	73.3100	78.9000
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6560	0.5423	0.9742	0.8272

Descriptive statistics of L *				
Media	48.5180	46.7530	46.2240	50.0080
Error típico	0.6459	0.7544	1.3624	0.6723
Mediana	48.7600	47.5750	46.7500	51.0950
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.0424	2.3855	4.3082	2.1259
Varianza de la muestra	4.1716	5.6905	18.5608	4.5193
Curtosis	3.4355	3.3833	0.3712	-0.8530
Coeficiente de asimetría	-1.4460	-1.7600	-0.5882	-0.8157
Rango	7.4200	7.6700	14.5900	5.9000
Mínimo	43.6600	41.0000	37.8600	46.1200
Máximo	51.0800	48.6700	52.4500	52.0200
Suma	485.1800	467.5300	462.2400	500.0800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.4611	1.7065	3.0819	1.5208

DYE B4	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	9.2	6.62	10.35	12.33	8.53	6.55	9.92	10.38
2	9.88	12.92	13.51	11.88	7.80	9.20	9.73	9.59
3	11.46	10.2	10.26	9.7	11.30	9.66	11.97	13.33
4	8.02	8.06	11.95	9.91	13.08	7.28	6.82	12.81
5	9.63	7.01	11.55	10.39	9.64	7.30	8.94	12.88
6	9.9	8.32	9.64	12.75	9.01	8.38	9.53	11.85
7	6.1	12.43	10.25	11.96	11.18	8.63	9.57	10.16
8	7.64	10.97	14.08	13.34	10.45	8.98	8.12	9.48
9	7.52	10	12.9	14.27	12.64	8.95	8.21	9.24
10	9	8.03	12.75	12.88	12.45	8.01	9.07	10.86
AVERAGE	8.84	9.46	11.72	11.94	10.61	8.29	9.19	11.06

PZ								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	5.25	6.69	4.46	3.83	9.53	10.85	9.50	6.46
2	8.96	4.74	3.41	6	9.87	11.23	5.57	7.25
3	8.09	7.84	6.34	9.49	10.94	8.31	6.85	6.42
4	4.39	4.76	1.5	8.65	7.66	9.97	11.13	6.60
5	6.11	5.45	3.74	8.66	9.01	9.91	9.18	7.07
6	6.14	7.17	6.36	2.34	8.31	10.10	9.59	7.51
7	8.06	3.55	5.79	4.78	9.65	9.49	8.97	6.08
8	6.92	4.94	2.59	-0.32	8.94	9.33	7.59	5.71
9	6.74	4.15	3.54	-1.64		9.51	7.70	6.67
10	5.66	4.7	2.33	4.19	8.28	9.73	8.33	5.38
AVERAGE	6.63	5.40	4.01	4.60	9.13	9.84	8.44	6.52

PZ								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	43.76	48.73	38.9	35.62	46.80	52.77	45.55	42.60
2	42.83	36.21	33.69	37.28	49.55	48.01	42.96	42.76
3	39.55	40.75	39.06	41.5	42.21	47.14	41.79	40.76
4	48.07	45.33	35.16	40.69	38.76	50.45	48.07	40.17
5	42.14	50.08	35.61	38.37	44.40	51.57	46.95	38.54
6	42.27	45.21	39.29	32.32	47.87	48.94	45.40	39.21
7	48.68	35.81	38.93	32.49	45.07	48.10	45.47	42.56
8	47.85	38.17	32.3	32.78	41.80	48.49	46.59	43.17
9	47.24	40.2	32.68	31.01	41.20	48.56	47.01	44.75
10	45.51	45.33	32.88	35.34	40.18	50.81	45.34	41.28
AVERAGE	44.79	42.58	35.85	35.74	43.78	49.48	45.51	41.58

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.23776	-1.29319	-0.88275	0.25696	-1.13519	-1.75907	0.53879	-0.43934
x2	0.68070	1.57955	1.14744	-0.04029	-1.53399	0.91383	0.39894	-0.95125
x3	1.70990	0.33926	-0.94057	-1.48033	0.37803	1.37780	2.04771	1.47224
x4	-0.53088	-0.63656	0.14520	-1.34161	1.35043	-1.02276	-1.74298	1.13528
x5	0.51785	-1.11535	-0.11179	-1.02454	-0.52881	-1.00259	-0.18254	1.18064
x6	0.69373	-0.51801	-1.33889	0.53440	-0.87297	0.08674	0.25173	0.51321
x7	-1.78155	1.35612	-0.94699	0.01255	0.31248	0.33890	0.28117	-0.58190
x8	-0.77841	0.69037	1.51365	0.92413	-0.08631	0.69193	-0.78611	-1.02253
x9	-0.85658	0.24806	0.75554	1.53846	1.11006	0.66167	-0.71986	-1.17805
x10	0.10748	-0.65024	0.65917	0.62027	1.00627	-0.28645	-0.08685	-0.12830

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.97519	0.93157	0.26652	-0.20380	0.50426	1.24520	0.66891	-0.08243
x2	1.64273	-0.47553	-0.34988	0.37205	0.71489	1.71509	-1.81345	1.10153
x3	1.02882	1.76139	1.37018	1.29819	1.37774	-1.89563	-1.00494	-0.14237
x4	-1.58204	-0.46109	-1.47116	1.07528	-0.65418	0.15704	1.69849	0.12739
x5	-0.36834	0.03680	-0.15616	1.07793	0.18213	0.08285	0.46678	0.83177
x6	-0.34717	1.27793	1.38192	-0.59920	-0.25151	0.31779	0.72576	1.49119
x7	1.00765	-1.33421	1.04730	0.04830	0.57860	-0.43650	0.33414	-0.65193
x8	0.20322	-0.33121	-0.83127	-1.30509	0.13876	-0.63435	-0.53753	-1.20644
x9	0.07621	-0.90126	-0.27357	-1.65537	-2.32059	-0.41177	-0.46805	0.23230
x10	-0.68588	-0.50439	-0.98390	-0.10827	-0.27010	-0.13973	-0.07011	-1.70100

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.33032	1.21356	1.03871	-0.01010	0.82413	1.81314	0.01949	0.52806
x2	-0.62857	-1.25778	-0.73561	0.12959	1.57557	-0.81332	-1.34496	0.61090
x3	-1.68046	-0.36162	1.09320	0.48470	-0.43010	-1.29336	-1.96133	-0.42452
x4	1.05189	0.54243	-0.23499	0.41654	-1.37281	0.53302	1.34706	-0.72997
x5	-0.84985	1.48004	-0.08173	0.22131	0.16832	1.15100	0.75703	-1.57384
x6	-0.80816	0.51875	1.17153	-0.28779	1.11650	-0.30017	-0.05953	-1.22697
x7	1.24752	-1.33674	1.04893	-0.27348	0.35140	-0.76366	-0.02265	0.50736
x8	0.98134	-0.87089	-1.20899	-0.24908	-0.54213	-0.54847	0.56738	0.82316
x9	0.78571	-0.47019	-1.07958	-0.39803	-0.70608	-0.50984	0.78864	1.64114
x10	0.23090	0.54243	-1.01147	-0.03366	-0.98480	0.73166	-0.09114	-0.15531

Descriptive statistics of a *

Media	8.8350	9.4560	11.7240	11.9410	10.6080	8.2940	9.1880	11.0580
Error típico	0.4855	0.6935	0.4922	0.4787	0.5789	0.3135	0.4296	0.4880
Mediana	9.1000	9.1600	11.7500	12.1450	10.8150	8.5050	9.3000	10.6200
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.5352	2.1930	1.5565	1.5139	1.8305	0.9914	1.3586	1.5432
Varianza de la muestra	2.3568	4.8094	2.4227	2.2917	3.3508	0.9829	1.8458	2.3816
Curtosis	0.0538	-1.1505	-1.5226	-0.9107	-1.3369	-0.7552	1.6808	-1.6413
Coeficiente de asimetría	-0.1531	0.3606	0.1290	-0.2633	-0.1323	-0.4868	0.3727	0.3592
Rango	5.3600	6.3000	4.4400	4.5700	5.2800	3.1100	5.1500	4.0900
Mínimo	6.1000	6.6200	9.6400	9.7000	7.8000	6.5500	6.8200	9.2400
Máximo	11.4600	12.9200	14.0800	14.2700	13.0800	9.6600	11.9700	13.3300
Suma	88.3500	94.5600	117.2400	119.4100	106.0800	82.9400	91.8800	110.5800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0982	1.5688	1.1135	1.0829	1.3095	0.7092	0.9719	1.1040

Descriptive statistics of b *

Media	6.6320	5.3990	4.0060	4.5980	8.7160	9.8430	8.4410	6.5150
Error típico	0.4481	0.4382	0.5387	1.1917	0.5105	0.2557	0.5006	0.2110
Mediana	6.4400	4.8500	3.6400	4.4850	8.9750	9.8200	8.6500	6.5300
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.4172	1.3858	1.7034	3.7683	1.6142	0.8087	1.5832	0.6673
Varianza de la muestra	2.0083	1.9205	2.9016	14.2004	2.6058	0.6540	2.5064	0.4452
Curtosis	-0.6599	-0.6186	-1.1747	-0.8282	2.9143	0.9441	0.2061	-0.5046
Coeficiente de asimetría	0.1739	0.6782	0.2224	-0.3123	-1.3196	-0.0292	-0.2106	-0.2383
Rango	4.5700	4.2900	4.8600	11.1300	5.9700	2.9200	5.5600	2.1300
Mínimo	4.3900	3.5500	1.5000	-1.6400	4.9700	8.3100	5.5700	5.3800
Máximo	8.9600	7.8400	6.3600	9.4900	10.9400	11.2300	11.1300	7.5100
Suma	66.3200	53.9900	40.0600	45.9800	87.1600	98.4300	84.4100	65.1500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0138	0.9914	1.2186	2.6957	1.1548	0.5785	1.1325	0.4773

Descriptive statistics of L *

Media	44.7900	42.5820	35.8500	32.1780	35.7400	49.4840	45.5130	41.5800
Error típico	0.9861	1.6020	0.9285	3.7579	1.1573	0.5731	0.6003	0.6108
Mediana	44.6350	42.9800	35.3850	34.0600	35.4800	48.7500	45.5100	41.9200
Moda	#N/A	45.3300	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	3.1182	5.0661	2.9363	11.8837	3.6596	1.8123	1.8982	1.9316
Varianza de la muestra	9.7231	25.6651	8.6220	141.2212	13.3929	3.2845	3.6032	3.7310
Curtosis	-1.2731	-1.3820	-2.0424	7.5581	-1.1996	-0.7006	0.5020	-0.6911
Coeficiente de asimetría	-0.2255	0.0414	0.0996	-2.6061	0.3629	0.6329	-0.8927	-0.1015
Rango	9.1300	14.2700	6.9900	41.5000	10.4900	5.6300	6.2800	6.2100
Mínimo	39.5500	35.8100	32.3000	0.0000	31.0100	47.1400	41.7900	38.5400
Máximo	48.6800	50.0800	39.2900	41.5000	41.5000	52.7700	48.0700	44.7500
Suma	447.9000	425.8200	358.5000	321.7800	357.4000	494.8400	455.1300	415.8000
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.2306	3.6240	2.1005	8.5011	2.6179	1.2965	1.3579	1.3818

ADA PROTOCOL — BLEACHING

CENTRAL ZONE														
BLEACHING B9	a				b					L				
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	9.58	10.42	10.19	7.57	1	4.20	4.01	2.96	5.61	1	43.04	41.20	42.29	46.99
2	9.14	6.36	7.86	9.11	2	3.30	10.68	4.48	3.10	2	44.10	49.08	47.44	44.50
3		6.90	10.97	8.58	3	9.89	11.75	2.68	3.48	3		47.60	41.16	44.43
4	8.68	10.80	7.87		4	9.00	3.69	4.35	6.67	4	44.54	41.46	49.38	48.25
5	9.23	8.47	7.88	8.21	5	6.64	7.84	4.58	3.83	5	42.54	44.56	46.72	46.04
6	8.28	9.06	9.62	7.82	6	7.17	7.65	3.83	3.53	6	45.16	43.94	44.39	47.04
7	8.84	9.97	7.38	7.66	7	5.32	4.87	4.58	4.47	7	43.00	42.14	48.25	46.62
8	9.41	10.01	7.12	8.01	8	5.73	3.88	5.49	3.72	8	42.98	43.89	47.95	45.93
9	9.34	9.35	7.44	8.53	9	7.91	5.58	5.18	2.64	9	43.47	43.73	46.85	45.69
10	8.46	7.70	9.49	8.48	10	8.11	8.65	3.46	2.62	10	44.72	46.23	43.60	45.18
AVERAGE	9.00	8.90	8.58	8.22	AVERAGE	6.73	6.86	4.16	3.97	AVERAGE	43.73	44.38	45.80	46.07

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	1.10141	1.00200	1.18409	-0.62635
x2	0.45868	-1.68146	-0.53166	1.43912
x3	-2.22911	-1.32454	1.75846	0.72828
x4	-0.21327	1.25316	-0.52430	-2.19556
x5	0.59014	-0.28685	-0.51694	0.23203
x6	-0.79757	0.10311	0.76436	-0.29104
x7	0.02045	0.70457	-0.88512	-0.50564
x8	0.85308	0.73101	-1.07658	-0.03621
x9	0.75083	0.29478	-0.84094	0.66122
x10	-0.53463	-0.79578	0.66863	0.59416

b	Z1	Z2	Z3	Z4
x1	-1.20181	-0.98112	-1.31083	1.26871
x2	-1.62984	1.31504	0.35094	-0.66949
x3	1.50428	1.68339	-1.61694	-0.37606
x4	1.08101	-1.09128	0.20881	2.08723
x5	-0.04138	0.33737	0.46027	-0.10579
x6	0.21068	0.27196	-0.35969	-0.33745
x7	-0.66915	-0.68506	0.46027	0.38841
x8	-0.47416	-1.02587	1.45514	-0.19073
x9	0.56262	-0.44064	1.11623	-1.02470
x10	0.65774	0.61621	-0.76419	-1.04014

L	Z1	Z2	Z3	Z4
x1	-0.74881	-1.22842	-1.27098	0.76936
x2	0.03243	1.81272	0.59226	-1.30616
x3	2.17714	1.24154	-1.67981	-1.36450
x4	0.35671	-1.12808	1.29414	1.81962
x5	-1.11731	0.06831	0.33176	-0.02251
x6	0.81366	-0.17097	-0.51121	0.81103
x7	-0.77829	-0.86564	0.88531	0.46095
x8	-0.79303	-0.19026	0.77677	-0.11419
x9	-0.43189	-0.25201	0.37880	-0.31424
x10	0.48938	0.71282	-0.79703	-0.73935

Descriptive statistics of a *				
Media	8.8260	8.9040	8.5820	8.0370
Error típico	0.2165	0.4784	0.4294	0.2358
Mediana	8.9900	9.2050	7.8750	8.1100
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.6846	1.5130	1.3580	0.7456
Varianza de la muestra	0.4686	2.2891	1.8442	0.5559
Curtosis	1.6983	-0.9578	-1.1194	1.8488
Coeficiente de asimetría	-1.2589	-0.5367	0.6770	-0.9868
Rango	2.2800	4.4400	3.8500	2.7100
Mínimo	7.3000	6.3600	7.1200	6.4000
Máximo	9.5800	10.8000	10.9700	9.1100
Suma	88.2600	89.0400	85.8200	80.3700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.4897	1.0823	0.9715	0.5334

Descriptive statistics of b *				
Media	6.7270	6.8600	4.1590	3.9670
Error típico	0.6649	0.9186	0.2892	0.4095
Mediana	6.9050	6.6150	4.4150	3.6250
Moda	#N/A	#N/A	4.5800	#N/A
Desviación estándar	2.1027	2.9049	0.9147	1.2950
Varianza de la muestra	4.4212	8.4382	0.8367	1.6771
Curtosis	-0.8104	-1.0886	-0.7842	0.9209
Coeficiente de asimetría	-0.1850	0.5009	-0.3130	1.1934
Rango	6.5900	8.0600	2.8100	4.0500
Mínimo	3.3000	3.6900	2.6800	2.6200
Máximo	9.8900	11.7500	5.4900	6.6700
Suma	67.2700	68.6000	41.5900	39.6700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.5042	2.0780	0.6543	0.9264

Descriptive statistics of L *				
Media	44.0560	44.3830	45.8030	46.0670
Error típico	0.4291	0.8194	0.8741	0.3794
Mediana	43.7850	43.9150	46.7850	45.9850
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3568	2.5911	2.7640	1.1997
Varianza de la muestra	1.8410	6.7140	7.6397	1.4393
Curtosis	1.2587	-0.4334	-1.0693	-0.3067
Coeficiente de asimetría	1.1327	0.5926	-0.5284	0.2647
Rango	4.4700	7.8800	8.2200	3.8200
Mínimo	42.5400	41.2000	41.1600	44.4300
Máximo	47.0100	49.0800	49.3800	48.2500
Suma	440.5600	443.8300	458.0300	460.6700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9706	1.8536	1.9773	0.8582

BLEACHING B9	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	8.14	5.65	9.88	12.04	7.20	8.33	9.75	11.94
2	13.25	8.05	12.27	13.51	7.33	11.69	9.20	10.46
3	13.88	12.38	12.76	10.09	11.12	8.72	11.68	10.52
4	13.39	9.05	11.95	11.07	9.66	7.90	12.00	11.34
5	7.18	9.59	11.12	11.96	7.37	10.08	11.83	11.97
6	9.57	10.97	13.69	12.39	6.64	8.95	9.40	11.17
7	9.43	11.79	12.19	11.5	7.38	8.97	9.46	11.07
8	9.12	14.1	13.75	12.69	7.48	10.09	9.98	10.30
9	7.73	17.47	13.13	12.43	8.46	10.17	9.37	10.79
10	9.8	20.36	12.11	13.4	9.89	10.64	10.09	10.72
AVERAGE	10.15	11.94	12.29	12.11	8.25	9.55	10.28	11.03

PZ								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	10.01	12.76	11.04	1.92	4.79	4.65	3.12	2.39
2	1.28	10.22	3.68	3.21	5.15	8.83	4.17	3.23
3	1.89	3.17	5.99	4.88	7.27	6.80		9.74
4	-0.71	6.09	9.23	3.06	6.41	5.74	3.50	7.76
5	9.65	6.94	6.69	1.9	7.29	6.46	2.57	5.52
6	7.52	6.29	6.48	0.53	6.68	4.53	4.03	5.76
7	5.88	3.19	4.15	6.36	6.83	5.53	3.37	4.95
8	6.35	1.63	2.71	3.18	8.60	4.67	3.10	5.90
9	8.35	-11.76	9.09	5.72	7.52	5.57	4.42	4.84
10	4.38	-9.68	9.26	4.38	8.55	7.99	3.91	2.93
AVERAGE	5.46	2.89	6.83	3.51	6.91	6.08	3.58	5.30

PZ								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	45.62	50.04	43.81	37.01	52.44	46.88	44.54	39.96
2	42.6	46.5	39.43	39.38	50.45	45.88	42.81	42.64
3	40.17	41.1	39.21	44.64	46.34	49.37	41.15	39.77
4	41.44	46.2	41.8	43.7	48.40	46.41	42.09	39.59
5	47.45	45.74	42.6	39.47	50.21	45.13	41.08	39.05
6	46.49	44.07	40.42	36.93	52.72	47.28	42.95	40.54
7	46.08	42.08	38.72	42.89	52.18	47.45	43.71	41.50
8	45.82	38.96	38.62	40.13	52.71	47.75	42.97	40.95
9	48.53	41.96	39.86	38.84	52.38	46.78	43.13	41.28
10	45.78	43.11	42.57	39.53	50.46	45.57	42.68	42.16
AVERAGE	45.00	43.98	40.70	40.25	50.83	46.85	42.71	40.74

STATISTICAL TREATMENT

Grubs tests

x1	-0.81434	-1.42313	-2.05280	-0.06549	-0.71311	-1.04613	-0.47217	1.55380
x2	1.25698	-0.88021	-0.01280	1.35027	-0.62507	1.82560	-0.96589	-0.96772
x3	1.51235	0.09931	0.40544	-1.94355	1.94159	-0.71280	1.26032	-0.86550
x4	1.31373	-0.65399	-0.28594	-0.99970	0.95285	-1.41364	1.54757	0.53156
x5	-1.20347	-0.53184	-0.99439	-0.14254	-0.59799	0.44956	1.39497	1.60492
x6	-0.23470	-0.21966	1.19924	0.27160	-1.09236	-0.51623	-0.78635	0.24193
x7	-0.29144	-0.03416	-0.08109	-0.58557	-0.59121	-0.49913	-0.73249	0.07156
x8	-0.41710	0.48840	1.25046	0.56053	-0.52349	0.45811	-0.26571	-1.24032
x9	-0.98053	1.25075	0.72125	0.31012	0.14018	0.52648	-0.81328	-0.40549
x10	-0.14147	1.90452	-0.14937	1.24433	1.10861	0.92818	-0.16697	-0.52475

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	1.23950	1.24773	1.51511	-0.87246	-1.69336	-0.98246	-0.25015	-1.30100
x2	-1.13870	0.92680	-1.13489	-0.16639	-1.40567	1.89539	0.89682	-0.92571
x3	-0.97253	0.03601	-0.30317	0.74766	0.28849	0.49777	-2.23824	1.98277
x4	-1.68082	0.40496	0.86341	-0.24849	-0.39877	-0.23202	0.16495	1.09816
x5	1.14143	0.51236	-0.05113	-0.88340	0.30447	0.26369	-0.85094	0.09740
x6	0.56118	0.43023	-0.12674	-1.63325	-0.18300	-1.06508	0.74389	0.20462
x7	0.11442	0.03854	-0.96567	1.55772	-0.06313	-0.37660	0.02294	-0.15726
x8	0.24245	-0.15857	-1.48414	-0.18281	1.35133	-0.96870	-0.27200	0.26717
x9	0.78729	-1.85044	0.81300	1.20743	0.48827	-0.34906	1.16991	-0.20641
x10	-0.29421	-1.58762	0.87421	0.47399	1.31137	1.31707	0.61281	-1.05974

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.23096	1.88592	1.67755	-1.22004	0.75799	0.02455	1.72344	-0.67043
x2	-0.89041	0.78497	-0.68809	-0.32815	-0.17832	-0.79370	0.09329	1.62135
x3	-1.79270	-0.89444	-0.80691	1.65131	-2.11212	2.06197	-1.47091	-0.83291
x4	-1.32113	0.69167	0.59195	1.29757	-1.14287	-0.36003	-0.58516	-0.98683
x5	0.91046	0.54861	1.02403	-0.29429	-0.29125	-1.40738	-1.53686	-1.44861
x6	0.55400	0.02923	-0.15339	-1.25015	0.88973	0.35184	0.22521	-0.17445
x7	0.40176	-0.58966	-1.07156	0.99274	0.63566	0.49095	0.94134	0.64649
x8	0.30522	-1.55999	-1.12557	-0.04591	0.88503	0.73642	0.24405	0.17616
x9	1.31147	-0.62698	-0.45585	-0.53137	0.72976	-0.05728	0.39482	0.45836
x10	0.29037	-0.26933	1.00783	-0.27171	-0.17362	-1.04735	-0.02921	1.21088

Descriptive statistics of a *

Media	10.1490	11.9410	12.2850	12.1080	8.2530	9.5540	10.2760	11.0280
Error típico	0.7801	1.3979	0.3705	0.3283	0.4670	0.3700	0.3523	0.1856
Mediana	9.5000	11.3800	12.2300	12.2150	7.4300	9.5250	9.8650	10.9300
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.4670	4.4205	1.1716	1.0383	1.4766	1.1700	1.1140	0.5869
Varianza de la muestra	6.0862	19.5412	1.3726	1.0781	2.1804	1.3690	1.2410	0.3445
Curtosis	-1.2381	0.1629	0.8014	0.2921	-0.2565	-0.4993	-1.2665	-0.7481
Coeficiente de asimetría	0.6074	0.6913	-0.7693	-0.5458	0.9827	0.3643	0.8300	0.6078
Rango	6.7000	14.7100	3.8700	3.4200	4.4800	3.7900	2.8000	1.6700
Mínimo	7.1800	5.6500	9.8800	10.0900	6.6400	7.9000	9.2000	10.3000
Máximo	13.8800	20.3600	13.7500	13.5100	11.1200	11.6900	12.0000	11.9700
Suma	101.4900	119.4100	122.8500	121.0800	82.5300	95.5400	102.7600	110.2800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.7648	3.1623	0.8381	0.7428	1.0563	0.8370	0.7969	0.4199

Descriptive statistics of b *

Media	5.4600	2.8850	6.8320	3.5140	6.9090	6.0770	3.3490	5.3020
Error típico	1.1608	2.5027	0.8783	0.5778	0.3957	0.4593	0.2895	0.7078
Mediana	6.1150	4.6400	6.5850	3.1950	7.0500	5.6550	3.4350	5.2350
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	3.6708	7.9143	2.7774	1.8270	1.2514	1.4525	0.9155	2.2383
Varianza de la muestra	13.4750	62.6368	7.7137	3.3380	1.5659	2.1097	0.8381	5.0099
Curtosis	-1.0416	0.3248	-1.2324	-0.6975	-0.2978	-0.1666	1.9026	0.4143
Coeficiente de asimetría	-0.4303	-1.0170	-0.0464	0.0456	-0.3905	0.8419	-1.2356	0.6875
Rango	10.7200	24.5200	8.3300	5.8300	3.8100	4.3000	3.1200	7.3500
Mínimo	-0.7100	-11.7600	2.7100	0.5300	4.7900	4.5300	1.3000	2.3900
Máximo	10.0100	12.7600	11.0400	6.3600	8.6000	8.8300	4.4200	9.7400
Suma	54.6000	28.8500	68.3200	35.1400	69.0900	60.7700	33.4900	53.0200
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.6260	5.6616	1.9868	1.3070	0.8952	1.0390	0.6549	1.6012

Descriptive statistics of L *

Media	44.9980	43.9760	40.7040	40.2520	50.8290	46.8500	42.7110	40.7440
Error típico	0.8516	1.0168	0.5855	0.8403	0.6721	0.3865	0.3356	0.3698
Mediana	45.8000	43.5900	40.1400	39.5000	51.3200	46.8300	42.8800	40.7450
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.6932	3.2154	1.8515	2.6573	2.1254	1.2221	1.0613	1.1694
Varianza de la muestra	7.2531	10.3389	3.4281	7.0612	4.5171	1.4936	1.1263	1.3675
Curtosis	-0.4571	0.0677	-1.3298	-0.8463	0.8187	0.8955	0.0291	-0.9965
Coeficiente de asimetría	-0.7587	0.3756	0.4750	0.5090	-1.1767	0.6729	-0.1349	0.2117
Rango	8.3600	11.0800	5.1900	7.7100	6.3800	4.2400	3.4600	3.5900
Mínimo	40.1700	38.9600	38.6200	36.9300	46.3400	45.1300	41.0800	39.0500
Máximo	48.5300	50.0400	43.8100	44.6400	52.7200	49.3700	44.5400	42.6400
Suma	449.9800	439.7600	407.0400	402.5200	508.2900	468.5000	427.1100	407.4400
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9266	2.3002	1.3245	1.9009	1.5204	0.8743	0.7592	0.8365

CZ													
ETCHING A6	a				b				L				
	Z1	Z2	Z3	Z4	Z1	Z2	Z3	Z4	Z1	Z2	Z3	Z4	
1	7.59	7.32	8.05	7.96	14.76	14.68	14.51	14.30	72.54	73.42	72.49	73.10	
2	7.31	7.63	8.14	8.43	15.52	14.38	13.21	14.88	72.87	72.64	73.36	73.26	
3	7.51	7.77	8.83	7.78	11.92	12.22	14.62	15.61	71.77	70.28	73.55	73.34	
4	7.94	7.60	9.55	7.67	12.35	12.26	15.13	14.52	71.01	71.65	72.20	72.80	
5	7.74	7.42	7.42	8.04	13.84	13.72		14.87	72.15	72.75	72.24	73.25	
6	7.66	7.52	9.62	8.30	13.02	11.54	14.53	13.85	71.61	71.26	71.95	73.24	
7	7.43	7.53	8.23	7.80	14.87	13.22	15.01	15.00	72.63	71.45	72.52	73.39	
8	7.51	7.57	8.42	7.57	13.30	14.32	15.56	15.25	72.48	72.45	72.95	73.03	
9	7.90	7.45	8.11	7.61	12.03	14.35	15.46	15.75	72.15	71.64	73.34	73.07	
10	7.38	7.21	7.79	7.76	12.22	14.07	14.94	14.67	71.92	71.26	73.85	73.68	
AVERAGE	7.60	7.50	8.42	7.89	13.38	13.48	15.05	14.87	72.11	71.88	72.85	73.22	

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-0.03294	-1.13514	-0.51033	0.23503
x2	-1.35058	0.79834	-0.38484	1.85953
x3	-0.40941	1.67152	0.57725	-0.38711
x4	1.61411	0.61123	1.58117	-0.76731
x5	0.67294	-0.51144	-1.38876	0.51154
x6	0.29647	0.11227	1.67878	1.41020
x7	-0.78588	0.17464	-0.25935	-0.31799
x8	-0.40941	0.42412	0.00558	-1.11295
x9	1.42588	-0.32433	-0.42667	-0.97470
x10	-1.02117	-1.82121	-0.87285	-0.45624

b	Z1	Z2	Z3	Z4
x1	1.05226	1.08781	-0.49384	-0.98543
x2	1.63303	0.81676	-1.67616	0.01729
x3	-1.11798	-1.13479	-0.39380	1.27933
x4	-0.78939	-1.09865	0.07003	-0.60509
x5	0.34922	0.22045	2.28005	0.00000
x6	-0.27739	-1.74917	-0.47566	-1.76340
x7	1.13632	-0.23130	-0.03911	0.22475
x8	-0.06343	0.76255	0.46110	0.65695
x9	-1.03392	0.78966	0.37016	1.52137
x10	-0.88873	0.53668	-0.10277	-0.34577

L	Z1	Z2	Z3	Z4
x1	0.76766	1.66980	-0.54326	-0.48872
x2	1.36093	0.82406	0.78812	0.18538
x3	-0.61664	-1.73485	1.07888	0.52242
x4	-1.98296	-0.24939	-0.98706	-1.75264
x5	0.06652	0.94333	-0.92585	0.14324
x6	-0.90429	-0.67226	-1.36964	0.10111
x7	0.92946	-0.46624	-0.49736	0.73308
x8	0.65979	0.61804	0.16068	-0.78363
x9	0.06652	-0.26023	0.75751	-0.61511
x10	-0.34697	-0.67226	1.53798	1.95487

Descriptive statistics of a *				
Media	7.5970	7.5020	8.4160	7.8920
Error típico	0.0672	0.0507	0.2268	0.0915
Mediana	7.5500	7.5250	8.1850	7.7900
Moda	7.5100	#N/A	#N/A	#N/A
Desviación estándar	0.2125	0.1603	0.7172	0.2893
Varianza de la muestra	0.0452	0.0257	0.5144	0.0837
Curtosis	-0.8502	0.2717	-0.2510	-0.2269
Coeficiente de asimetría	0.4561	-0.3029	0.7289	0.8944
Rango	0.6300	0.5600	2.2000	0.8600
Mínimo	7.3100	7.2100	7.4200	7.5700
Máximo	7.9400	7.7700	9.6200	8.4300
Suma	75.9700	75.0200	84.1600	78.9200
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.1520	0.1147	0.5130	0.2070

Descriptive statistics of b*				
Media	13.3830	13.4760	15.0530	14.8700
Error típico	0.4138	0.3500	0.3477	0.1829
Mediana	13.1600	13.8950	14.9750	14.8750
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3086	1.1068	1.0995	0.5784
Varianza de la muestra	1.7125	1.2250	1.2090	0.3346
Curtosis	-1.3399	-1.0356	3.3254	-0.1956
Coeficiente de asimetría	0.4600	-0.7248	0.9726	-0.1102
Rango	3.6000	3.1400	4.3500	1.9000
Mínimo	11.9200	11.5400	13.2100	13.8500
Máximo	15.5200	14.6800	17.5600	15.7500
Suma	133.8300	134.7600	150.5300	148.7000
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9361	0.7918	0.7866	0.4138

Descriptive statistics of L*				
Media	72.1130	71.8800	72.8450	73.2160
Error típico	0.1759	0.2916	0.2066	0.0751
Mediana	72.1500	71.6450	72.7350	73.2450
Moda	72.1500	71.2600	#N/A	#N/A
Desviación estándar	0.5562	0.9223	0.6535	0.2374
Varianza de la muestra	0.3094	0.8506	0.4270	0.0563
Curtosis	0.2447	-0.2589	-1.4983	1.1131
Coeficiente de asimetría	-0.6596	0.0455	0.1686	0.2504
Rango	1.8600	3.1400	1.9000	0.8800
Mínimo	71.0100	70.2800	71.9500	72.8000
Máximo	72.8700	73.4200	73.8500	73.6800
Suma	721.1300	718.8000	728.4500	732.1600
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.3979	0.6598	0.4675	0.1698

ETCHING A6	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	8.02	8.29	8.31	9.8	9.88	8.48	8.62	
2	7.64	8.24	8.87	8.65	9.38	8.71	8.92	9.65
3	8.12	9.56	8.63	9.69	9.40	8.85	10.24	9.11
4	9.43	8.93	8.55	9.83	9.14	10.34	10.45	9.34
5	8.99	8.3	9.41	10.89	10.80	9.65	9.45	8.64
6	7.84	8.44	9.32	9.82	9.73	9.90	10.32	9.26
7	8.69	9.08	10.16	8.74	10.22	9.58	8.76	9.34
8	7.59	9.07	9.36	10.24	10.35	8.80	9.55	9.65
9	9.04	8.56	9.35	8.03	10.09	8.61	8.97	9.11
10	8.28	9.42	9.55	10.74	9.51	9.13	8.91	9.30
AVERAGE	8.36	8.79	9.15	9.64	9.85	9.21	9.42	9.27

PZ								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	13.06	11.31	12.44	15.47		15.83	15.83	14.36
2	12.37	11.63	13.95	13.64	16.48	14.40	12.86	14.07
3	14.46	11.23	13.95	15.14	15.02	15.63	14.26	13.56
4	11.8	12.24	13.24	15.39	16.38	14.71	14.04	11.19
5	12.17	11.68	12.91	14.96	15.67	15.57	15.03	12.07
6	11.44	11.87	14.01	15.46	15.52	15.61	14.31	12.21
7	11.52	11.4	13.66	15.22	16.33	15.52	13.51	12.39
8	13.31	11.59	15.24	15.31	15.63	15.98	14.18	15.05
9	11.03		15.71		16.11	16.60	14.69	12.44
10	11.96	12.04	15.07	15.42	16.67	15.89	14.76	12.83
AVERAGE	12.31	11.67	14.02	15.11	15.98	15.57	14.35	13.02

PZ								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	69.98	69.61	68.87	71.29	71.56	73.36	72.98	72.45
2	70.3	68.84	71.19	71.88	71.79	72.99	72.55	71.22
3	67.94	66.63	70.55	71.45	73.27	72.72	71.92	71.88
4	68.88	67.7	69.66	70.54	72.31	71.30	73.21	70.25
5	68.24	68.62	67.07	69.91	71.30	71.82	72.90	71.38
6	70.09	68.11	67.48	70.36	72.44	71.57	72.91	70.50
7	68.48	67.42	67.49	70.52	71.50	71.70	73.06	70.89
8	69.89	67.09	68.02	69.38	71.08	72.54	72.44	70.44
9	69.18	66.99	69.5	70.69	72.23	73.15	72.71	71.29
10	69.62	65.88	68.82	70.33	71.88	73.26	72.56	71.06
AVERAGE	69.26	67.69	68.87	70.64	71.94	72.44	72.72	71.14

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.53839	-1.02335	-1.51453	0.17072	0.05803	-1.15759	-1.14937	-2.34011
x2	-1.13312	-1.12589	-0.50604	-1.07980	-0.90913	-0.79036	-0.71782	1.01701
x3	-0.38188	1.58117	-0.93825	0.05111	-0.87044	-0.56682	1.18101	-0.04937
x4	1.66838	0.28916	-1.08232	0.20335	-1.37336	1.81223	1.48310	0.40483
x5	0.97974	-1.00285	0.46643	1.35600	1.83760	0.71052	0.04459	-0.97751
x6	-0.82010	-0.71573	0.30435	0.19247	-0.23212	1.10969	1.29610	0.24685
x7	0.51022	0.59679	1.81708	-0.98193	0.71570	0.59876	-0.94798	0.40483
x8	-1.21137	0.57628	0.37638	0.64919	0.96716	-0.64666	0.18844	1.01701
x9	1.05800	-0.46964	0.35837	-1.75400	0.46424	-0.95003	-0.64589	-0.04937
x10	-0.13147	1.29406	0.71855	1.19289	-0.65767	-0.11975	-0.73220	0.32584

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.72386	-0.92879	-1.50279	-0.15884	-2.59745	0.40963	1.81678	1.11799
x2	0.05613	-0.31975	-0.06476	-0.92175	0.68714	-1.87856	-1.82168	0.87657
x3	2.07869	-1.08105	-0.06476	-0.29641	-0.47400	0.08961	-0.10658	0.45202
x4	-0.49548	0.84124	-0.74092	-0.19219	0.60761	-1.38252	-0.37610	-1.52089
x5	-0.13742	-0.22458	-1.05519	-0.37145	0.04295	-0.00640	0.83672	-0.78833
x6	-0.84386	0.13703	-0.00762	-0.16300	-0.07635	0.05760	-0.04533	-0.67179
x7	-0.76645	-0.75749	-0.34094	-0.26306	0.56784	-0.08641	-1.02538	-0.52195
x8	0.96580	-0.39588	1.16376	-0.22554	0.01113	0.64965	-0.20459	1.69238
x9	-1.24063	2.26868	1.61136	2.77191	0.39288	1.64174	0.42020	-0.48033
x10	-0.34064	0.46059	1.00186	-0.17968	0.83825	0.50564	0.50595	-0.15567

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.85667	1.70889	0.00364	0.88429	-0.58226	1.18617	0.68293	1.94429
x2	1.23741	1.02391	1.69034	1.68082	-0.22609	0.70861	-0.46418	0.12429
x3	-1.57056	-0.94207	1.22504	1.10030	2.06579	0.36011	-2.14483	1.10088
x4	-0.45213	0.00979	0.57799	-0.12826	0.57916	-1.47271	1.29650	-1.31099
x5	-1.21362	0.82820	-1.30502	-0.97879	-0.98489	-0.80154	0.46952	0.36104
x6	0.98755	0.37451	-1.00693	-0.37127	0.78048	-1.12422	0.49619	-0.94107
x7	-0.92806	-0.23930	-0.99966	-0.15526	-0.67517	-0.95642	0.89635	-0.36400
x8	0.74959	-0.53286	-0.61434	-1.69432	-1.32557	0.12778	-0.75763	-1.02985
x9	-0.09519	-0.62182	0.46166	0.07425	0.45528	0.91512	-0.03735	0.22787
x10	0.42834	-1.60925	-0.03272	-0.41177	-0.08672	1.05710	-0.43750	-0.11246

Descriptive statistics of a *

Media	8.3640	8.7890	9.1510	9.6430	9.8500	9.2050	9.4190	9.1350
Error típico	0.2021	0.1542	0.1756	0.2908	0.1635	0.1981	0.2198	0.1601
Mediana	8.2000	8.7450	9.3350	9.8100	9.8050	8.9900	9.2100	9.2800
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	9.6500
Desviación estándar	0.6389	0.4876	0.5553	0.9196	0.5170	0.6263	0.6952	0.5064
Varianza de la muestra	0.4082	0.2378	0.3083	0.8457	0.2673	0.3923	0.4833	0.2564
Curtosis	-1.2074	-1.4310	-0.2503	-0.5544	-0.5000	-0.8550	-1.5267	2.8869
Coeficiente de asimetría	0.4032	0.3570	0.1253	-0.4329	0.4553	0.6299	0.5127	-1.5921
Rango	1.8400	1.3200	1.8500	2.8600	1.6600	1.8600	1.8300	1.7000
Mínimo	7.5900	8.2400	8.3100	8.0300	9.1400	8.4800	8.6200	7.9500
Máximo	9.4300	9.5600	10.1600	10.8900	10.8000	10.3400	10.4500	9.6500
Suma	83.6400	87.8900	91.5100	96.4300	98.5000	92.0500	94.1900	91.3500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.4571	0.3488	0.3972	0.6579	0.3698	0.4480	0.4973	0.3622

Descriptive statistics of b *

Media	12.3120	11.7980	14.0180	15.8510	15.6160	15.5740	14.3470	13.0170
Error típico	0.3268	0.1662	0.3321	0.7585	0.3976	0.1976	0.2581	0.3799
Mediana	12.0650	11.6550	13.9500	15.3500	15.8900	15.6200	14.2850	12.6350
Moda	#N/A	#N/A	13.9500	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.0333	0.5254	1.0500	2.3987	1.2574	0.6249	0.8163	1.2013
Varianza de la muestra	1.0678	0.2761	1.1026	5.7538	1.5810	0.3906	0.6663	1.4430
Curtosis	0.7047	2.1021	-0.7952	8.7113	5.8203	0.8210	0.8162	-0.7455
Coeficiente de asimetría	0.9914	1.3565	0.2430	2.8315	-2.2569	-0.6076	-0.0556	0.3392
Rango	3.4300	1.7600	3.2700	8.8600	4.3200	2.2000	2.9700	3.8600
Mínimo	11.0300	11.2300	12.4400	13.6400	12.3500	14.4000	12.8600	11.1900
Máximo	14.4600	12.9900	15.7100	22.5000	16.6700	16.6000	15.8300	15.0500
Suma	123.1200	117.9800	140.1800	158.5100	156.1600	155.7400	143.4700	130.1700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.7392	0.3759	0.7512	1.7159	0.8995	0.4471	0.5839	0.8593

Descriptive statistics of L *

Media	69.2600	67.6890	68.8650	70.6350	71.9360	72.4410	72.7240	71.1360
Error típico	0.2658	0.3555	0.4350	0.2342	0.2042	0.2450	0.1185	0.2137
Mediana	69.4000	67.5600	68.8450	70.5300	71.8350	72.6300	72.8050	71.1400
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.8405	1.1241	1.3755	0.7407	0.6458	0.7748	0.3749	0.6758
Varianza de la muestra	0.7064	1.2637	1.8919	0.5487	0.4170	0.6003	0.1405	0.4567
Curtosis	-1.4537	-0.4446	-0.9252	-0.1344	0.7006	-1.7748	1.1985	0.1699
Coeficiente de asimetría	-0.3567	0.1772	0.3452	0.1172	0.8025	-0.2755	-0.9780	0.6273
Rango	2.3600	3.7300	4.1200	2.5000	2.1900	2.0600	1.2900	2.2000
Mínimo	67.9400	65.8800	67.0700	69.3800	71.0800	71.3000	71.9200	70.2500
Máximo	70.3000	69.6100	71.1900	71.8800	73.2700	73.3600	73.2100	72.4500
Suma	692.6000	676.8900	688.6500	706.3500	719.3600	724.4100	727.2400	711.3600
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6012	0.8041	0.9839	0.5299	0.4619	0.5542	0.2682	0.4835

CENTRAL ZONE														
DYE A4	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	18.54	20.00		21.19	1		14.93	18.32	17.80	1	42.45	43.51		40.71
2		15.15	19.09	19.15	2	15.11	16.82	16.61		2	37.99	46.67	45.38	45.19
3	22.18	19.47	15.29	19.93	3	15.74	17.05	18.83	18.39	3	38.38	44.20	49.59	44.56
4	21.15	16.18	17.93		4	16.74	17.29	20.83	18.26	4	41.76	47.18	48.37	41.13
5	21.13	16.69	20.50	20.52	5	14.82	15.87	18.50	18.40	5	40.10	46.82	45.70	43.24
6	20.44	16.89	18.95	20.61	6	15.63	16.70	19.77	17.80	6	40.41	45.50	46.27	44.00
7	19.71	17.84	17.50	20.46	7	15.48	16.80	18.42	18.30	7	42.23	46.36	47.17	43.33
8	20.98	17.05	17.34	20.48	8	14.34	15.65	18.23	17.49	8	41.75	43.53	45.97	41.96
9	20.94	18.23	16.24	20.15	9	14.33	14.53	18.21	17.90	9	40.67	43.67	47.68	42.47
10	21.81	17.55	16.60	19.71	10	14.85	17.52	17.88	18.04	10	40.13	44.29	47.22	42.02
AVERAGE	20.76	17.51	17.72	20.24	AVERAGE	15.23	16.32	18.56	18.04	AVERAGE	40.59	45.17	47.04	42.86

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-1.51461	1.70478	2.37999	0.48142
x2	2.30868	-1.60912	0.23247	-1.16640
x3	0.54408	1.34265	-1.14137	-0.53635
x4	-0.03846	-0.90535	-0.18691	2.54119
x5	-0.04977	-0.55687	0.74223	-0.05977
x6	-0.44002	-0.42022	0.18185	0.01292
x7	-0.85289	0.22890	-0.34237	-0.10824
x8	-0.13461	-0.31089	-0.40022	-0.09208
x9	-0.15723	0.49538	-0.79791	-0.35864
x10	0.33482	0.03075	-0.66776	-0.71405

b	Z1	Z2	Z3	Z4
x1	2.23420	-1.36156	-0.21450	-0.18790
x2	-0.34834	0.49511	-1.74282	-2.36459
x3	0.19219	0.72106	0.24131	0.90974
x4	1.05018	0.95682	2.02882	0.66789
x5	-0.59716	-0.43813	-0.05363	0.92835
x6	0.09781	0.37723	1.08144	-0.18790
x7	-0.03089	0.47546	-0.12513	0.74231
x8	-1.00900	-0.65425	-0.29494	-0.76463
x9	-1.01758	-1.75450	-0.31281	-0.00186
x10	-0.57142	1.18277	-0.60775	0.25860

L	Z1	Z2	Z3	Z4
x1	1.21967	-1.11703	-2.23455	-1.47013
x2	-1.70021	1.00553	-0.54701	1.59179
x3	-1.44488	-0.65356	1.47132	1.16120
x4	0.76794	1.34809	0.88644	-1.18308
x5	-0.31883	1.10628	-0.39360	0.25903
x6	-0.11588	0.21964	-0.12033	0.77847
x7	1.07564	0.79730	0.31114	0.32054
x8	0.76139	-1.10359	-0.26416	-0.61580
x9	0.05434	-1.00956	0.55564	-0.26723
x10	-0.29919	-0.59311	0.33511	-0.57479

Descriptive statistics of a *				
Media	21.2180	17.5050	18.4470	20.5940
Error típico	0.5591	0.4628	0.8747	0.3915
Mediana	21.0550	17.3000	17.7150	20.4700
Desviación estándar	1.7681	1.4635	2.7660	1.2380
Varianza de la muestra	3.1262	2.1419	7.6506	1.5326
Curtosis	3.1554	-0.1331	3.2416	5.2563
Coeficiente de asimetría	1.1552	0.3226	1.5979	1.9956
Rango	6.7600	4.8500	9.7400	4.5900
Mínimo	18.5400	15.1500	15.2900	19.1500
Máximo	25.3000	20.0000	25.0300	23.7400
Suma	212.1800	175.0500	184.4700	205.9400
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.2648	1.0469	1.9787	0.8856

Descriptive statistics of b *				
Media	15.5160	16.3160	18.5600	17.9010
Error típico	0.3686	0.3219	0.3538	0.1700
Mediana	15.2950	16.7500	18.3700	17.9700
Desviación estándar	1.1655	1.0180	1.1189	0.5375
Varianza de la muestra	1.3584	1.0362	1.2519	0.2889
Curtosis	1.8791	-0.7753	1.7053	2.9813
Coeficiente de asimetría	1.3605	-0.7085	0.5616	-1.5839
Rango	3.7900	2.9900	4.2200	1.7700
Mínimo	14.3300	14.5300	16.6100	16.6300
Máximo	18.1200	17.5200	20.8300	18.4000
Suma	155.1600	163.1600	185.6000	179.0100
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8338	0.7282	0.8004	0.3845

Descriptive statistics of L*				
Media	40.5870	45.1730	46.5210	42.8610
Error típico	0.4830	0.4708	0.6596	0.4627
Mediana	40.5400	44.8950	46.7200	42.8550
Desviación estándar	1.5275	1.4888	2.0859	1.4631
Varianza de la muestra	2.3331	2.2164	4.3509	2.1408
Curtosis	-0.6358	-2.0226	2.3113	-0.9544
Coeficiente de asimetría	-0.5609	0.1505	-1.0113	0.1174
Rango	4.4600	3.6700	7.7300	4.4800
Mínimo	37.9900	43.5100	41.8600	40.7100
Máximo	42.4500	47.1800	49.5900	45.1900
Suma	405.8700	451.7300	465.2100	428.6100
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0927	1.0650	1.4921	1.0467

	PERIPHERAL ZONE							
	a							
DYE A4	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	21.83	17.87	16.09	18.66	25.65	25.23		18.38
2	21.57	16.99	16.61	16.29	20.91	25.51	18.72	20.68
3	23.76	17.11	15.57	15.86	24.96	24.88	19.49	18.47
4	25.61	17.42	15.85	16.05	21.00	22.44	19.01	18.14
5	21.15	17.33	15.27	15.84	24.86	23.40	18.89	19.24
6	21.4	18.02	15.8	15.84	25.37	25.26	18.93	19.07
7	21.21	18.46	16.48	16.35	24.58	25.21	18.92	19.32
8	23.17	20.42	15.86	15.91	21.91	23.21	18.78	19.14
9	21.93	21.39	16.37	16.11	24.49	24.66	18.65	19.28
10	24.99	20.54	15.66	18.43	24.89	24.21	18.67	20.09
AVERAGE	22.66	18.56	15.96	16.53	23.86	24.40	18.90	19.18

PERIPHERAL ZONE								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	18.3	21.23	19.1	20.35	19.52	21.41	19.58	16.30
2	20.11	18.69	19.23	20.44	20.02	21.82	16.99	17.28
3	14.82	21.62	16.58	19.46	22.36	21.10	19.40	16.01
4	21.13	22.16	17.67	21.16	24.02	21.72	21.05	17.06
5	23.26	20.39	17.06	17.16	22.88	20.78	18.52	14.19
6	22.66	22.97	15.52	17.79	21.35	19.87	18.96	16.57
7	20.11	22.28	15.37	17.89	20.48	20.30	19.10	15.10
8	15.92	21.4	16.21	17.12	22.71	21.01	19.59	16.81
9	21.61	18.91	14.86	18.28	22.46		19.07	16.92
10	18.25	19.18	17.87	21.08	19.94	20.23		17.27
AVERAGE	19.62	20.88	16.95	19.07	21.57	20.92	19.14	16.35

PERIPHERAL ZONE								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	42.31	44.03	48.87	49.83	46.10	47.36	46.38	45.59
2	41.97	46.95	50.53	48.8	51.33	46.54	44.91	41.07
3	39.69	46.82	50.31	50.22	46.77	46.38	45.79	45.32
4	38.77	47.26	49.22	50.24	50.06	49.03	47.04	44.54
5	42.53	46.73	47.65	48.47	49.24	49.02	47.12	42.91
6	41.55	47.18	48.14	49.21	48.73	47.16	46.54	44.07
7	44.3	47.49	49.31	49.88	48.32	48.02	46.24	42.90
8	39.35	46.37	48.45	49.02	48.76	48.91	45.47	42.79
9	36.55	45.29	47.72	49.99	47.98	47.42	45.15	44.51
10	44.91	44.13	48.03	49.9	47.30	49.45	43.78	43.28
AVERAGE	41.19	46.23	48.82	49.56	48.46	47.93	45.84	43.70

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.50969	-0.42350	0.31356	1.97498	0.97359	0.79008	2.24111	-1.03884
x2	-0.66897	-0.96755	1.53037	-0.22667	-1.60740	1.05694	-0.69763	1.94410
x3	0.67264	-0.89336	-0.90324	-0.62612	0.59787	0.45651	1.27005	-0.92212
x4	1.80597	-0.70171	-0.24804	-0.44962	-1.55839	-1.86894	0.04344	-1.35010
x5	-0.92626	-0.75735	-1.60525	-0.64470	0.54342	-0.95401	-0.26321	0.07652
x6	-0.77311	-0.33076	-0.36504	-0.64470	0.82112	0.81867	-0.16099	-0.14396
x7	-0.88951	-0.05873	1.22617	-0.17093	0.39096	0.77102	-0.18655	0.18027
x8	0.31120	1.15303	-0.22464	-0.57967	-1.06288	-1.13509	-0.54431	-0.05317
x9	-0.44843	1.75272	0.96876	-0.39388	0.34195	0.24684	-0.87651	0.12840
x10	1.42615	1.22722	-0.69264	1.76132	0.55976	-0.18203	-0.82540	1.17891

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.47372	0.22873	1.41652	0.79569	-1.34682	0.24399	0.51530	-0.05059
x2	0.17733	-1.44553	1.50205	0.85177	-1.01897	0.64899	-1.03298	0.92153
x3	-1.72547	0.48580	-0.24146	0.24114	0.51539	-0.06223	0.40769	-0.33826
x4	0.54422	0.84174	0.47568	1.30040	1.60386	0.55021	1.39405	0.70330
x5	1.31038	-0.32496	0.07435	-1.19198	0.85635	-0.37833	-0.11836	-2.14362
x6	1.09456	1.37566	-0.93886	-0.79943	-0.14688	-1.27723	0.14467	0.21724
x7	0.17733	0.92084	-1.03755	-0.73712	-0.71734	-0.85247	0.22836	-1.24094
x8	-1.32981	0.34078	-0.48489	-1.21691	0.74488	-0.15113	0.52127	0.45531
x9	0.71688	-1.30052	-1.37309	-0.49412	0.58096	2.19984	0.21042	0.56443
x10	-0.49171	-1.12255	0.60727	1.25055	-1.07142	-0.92162	-2.27041	0.91161

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.43146	-1.71051	0.04611	0.43606	-1.52310	-0.51030	0.51705	1.38149
x2	0.30013	0.56497	1.67483	-1.20315	1.85367	-1.24571	-0.89571	-1.91890
x3	-0.58056	0.46367	1.45898	1.05673	-1.09051	-1.38921	-0.04998	1.18435
x4	-0.93593	0.80655	0.38952	1.08856	1.03369	0.98742	1.15136	0.61481
x5	0.51644	0.39353	-1.15090	-1.72833	0.50426	0.97846	1.22824	-0.57538
x6	0.13790	0.74421	-0.67013	-0.55065	0.17497	-0.68967	0.67082	0.27163
x7	1.20014	0.98578	0.47782	0.51563	-0.08975	0.08161	0.38250	-0.58268
x8	-0.71189	0.11299	-0.36597	-0.85302	0.19434	0.87980	-0.35752	-0.66300
x9	-1.79345	-0.72862	-1.08222	0.69070	-0.30927	-0.45649	-0.66506	0.59290
x10	1.43576	-1.63258	-0.77806	0.54746	-0.74831	1.36410	-1.98172	-0.30521

Descriptive statistics of a *

Media	22.6620	18.5550	15.9560	16.5340	23.8620	24.4010	18.9930	19.1810
Error típico	0.5162	0.5115	0.1351	0.3404	0.5808	0.3318	0.1237	0.2438
Mediana	21.8800	17.9450	15.8550	16.0800	24.7200	24.7700	18.9050	19.1900
Moda	#N/A	#N/A	#N/A	15.8400	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.6324	1.6175	0.4273	1.0765	1.8365	1.0493	0.3913	0.7711
Varianza de la muestra	2.6646	2.6163	0.1826	1.1588	3.3728	1.1009	0.1531	0.5945
Curtosis	-0.6255	-0.9341	-0.8045	1.2303	-0.9448	-0.5902	2.0367	0.3375
Coeficiente de asimetría	0.9226	0.8687	0.1509	1.6698	-0.9740	-0.8436	1.6027	0.6424
Rango	4.4600	4.4000	1.3400	2.8200	4.7400	3.0700	1.2200	2.5400
Mínimo	21.1500	16.9900	15.2700	15.8400	20.9100	22.4400	18.6500	18.1400
Máximo	25.6100	21.3900	16.6100	18.6600	25.6500	25.5100	19.8700	20.6800
Suma	226.6200	185.5500	159.5600	165.3400	238.6200	244.0100	189.9300	191.8100
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.1677	1.1571	0.3057	0.7701	1.3138	0.7506	0.2799	0.5516

Descriptive statistics of b *

Media	19.6170	20.8830	16.9470	19.0730	21.5740	21.1630	18.7180	16.3510
Error típico	0.8791	0.4797	0.4806	0.5075	0.4823	0.3201	0.5290	0.3188
Mediana	20.1100	21.3150	16.8200	18.8700	21.8550	21.0550	19.0850	16.6900
Moda	20.1100	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.7801	1.5171	1.5199	1.6049	1.5251	1.0123	1.6728	1.0081
Varianza de la muestra	7.7290	2.3016	2.3102	2.5757	2.3258	1.0248	2.7984	1.0163
Curtosis	-0.6644	-1.3491	-1.0976	-1.8925	-1.3713	1.6896	2.5715	1.1832
Coeficiente de asimetría	-0.5016	-0.3503	0.2641	0.1059	0.0551	1.0495	-1.3511	-1.3372
Rango	8.4400	4.2800	4.3700	4.0400	4.5000	3.5200	6.1300	3.0900
Mínimo	14.8200	18.6900	14.8600	17.1200	19.5200	19.8700	14.9200	14.1900
Máximo	23.2600	22.9700	19.2300	21.1600	24.0200	23.3900	21.0500	17.2800
Suma	196.1700	208.8300	169.4700	190.7300	215.7400	211.6300	187.1800	163.5100
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9888	1.0853	1.0873	1.1481	1.0910	0.7242	1.1967	0.7212

Descriptive statistics of L *

Media	41.1930	46.2250	48.8230	49.5560	48.4590	47.9290	45.8420	43.6980
Error típico	0.8187	0.4058	0.3223	0.1987	0.4898	0.3526	0.3290	0.4331
Mediana	41.7600	46.7750	48.6600	49.8550	48.5250	47.7200	46.0150	43.6750
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.5889	1.2832	1.0192	0.6284	1.5488	1.1150	1.0405	1.3695
Varianza de la muestra	6.7022	1.6467	1.0388	0.3948	2.3988	1.2433	1.0827	1.8756
Curtosis	-0.4278	-0.4559	-0.8064	-1.1276	0.0551	-1.6332	0.1583	-0.0032
Coeficiente de asimetría	-0.3068	-1.0424	0.6054	-0.6262	0.3244	-0.0071	-0.6897	-0.4188
Rango	8.3600	3.4600	2.8800	1.7700	5.2300	3.0700	3.3400	4.5200
Mínimo	36.5500	44.0300	47.6500	48.4700	46.1000	46.3800	43.7800	41.0700
Máximo	44.9100	47.4900	50.5300	50.2400	51.3300	49.4500	47.1200	45.5900
Suma	411.9300	462.2500	488.2300	495.5600	484.5900	479.2900	458.4200	436.9800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.8520	0.9180	0.7291	0.4495	1.1080	0.7976	0.7443	0.9797

CENTRAL ZONE														
BLEACHING A7	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	4.75	4.36	5.21	9.13	1	19.78	18.33	16.49	19.97	1	76.30	74.74	73.69	66.97
2	5.37	5.90	9.11	5.01	2	16.43	15.63	16.34	19.20	2	73.64	72.61	63.55	76.42
3	5.44	4.74	7.80	8.08	3	16.36	19.64	16.75	19.98	3	74.03	74.03	65.62	69.00
4	5.18	5.17	7.19	7.13	4	17.22	19.43	16.65	20.59	4	74.60	73.44	66.22	70.58
5	5.04	5.54	6.54	6.55	5	17.87	18.62	15.40	19.46	5	74.98	73.54	67.74	72.62
6	4.48	5.27	5.53	6.73	6	20.04	18.93	15.75	18.09	6	76.53	73.57	73.08	74.70
7	4.48	5.39	5.60	5.20	7	18.92	18.07	13.53	19.31	7	77.32	73.44	74.31	75.62
8	4.94	5.56	8.23	5.97	8	18.12	17.77	16.07	18.63	8	76.09	73.03	65.53	75.23
9	5.25	5.22	5.10	6.02	9	16.80	17.62	14.84	18.27	9	75.85	74.04	74.98	74.99
10	5.24	5.81	5.26	6.37	10	17.09	16.16	14.43	18.78	10	75.55	72.21	74.91	74.05
AVERAGE	5.02	5.30	6.56	6.62	**AVERAGE**	17.86	18.02	15.63	19.23	**AVERAGE**	75.49	73.47	69.96	73.02

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	-0.76771	-1.99827	-0.93068	2.00171
x2	1.01499	1.28948	1.76394	-1.28266
x3	1.21626	-1.18700	0.85882	1.16467
x4	0.46868	-0.26900	0.43736	0.40736
x5	0.06613	0.52092	-0.01175	-0.05501
x6	-1.54404	-0.05551	-0.70958	0.08849
x7	-1.54404	0.20068	-0.66122	-1.13119
x8	-0.22140	0.56361	1.15592	-0.51737
x9	0.66995	-0.16225	-1.00668	-0.47751
x10	0.64119	1.09734	-0.89613	-0.19850

b	Z1	Z2	Z3	Z4
x1	1.43546	0.23781	0.80962	0.92401
x2	-1.07304	-1.83344	0.66923	-0.03487
x3	-1.12546	1.24275	1.05298	0.93647
x4	-0.48148	1.08165	0.95938	1.69610
x5	0.00524	0.46028	-0.21060	0.28891
x6	1.63015	0.69809	0.11700	-1.41715
x7	0.79149	0.03836	-1.96088	0.10211
x8	0.19244	-0.19178	0.41651	-0.74469
x9	-0.79598	-0.30685	-0.73475	-1.19300
x10	-0.57883	-1.42686	-1.11850	-0.55789

L	Z1	Z2	Z3	Z4
x1	0.69696	1.74793	0.80959	-1.91420
x2	-1.58901	-1.17214	-1.39304	1.07674
x3	-1.25385	0.77457	-0.94339	-1.27170
x4	-0.76400	-0.03427	-0.81306	-0.77163
x5	-0.43743	0.10282	-0.48288	-0.12597
x6	0.89462	0.14395	0.67708	0.53235
x7	1.57354	-0.03427	0.94426	0.82354
x8	0.51649	-0.59635	-0.96294	0.70010
x9	0.31024	0.78828	1.08980	0.62414
x10	0.05242	-1.72051	1.07460	0.32663

Descriptive statistics of a *				
Media	5.0170	5.2960	6.5570	6.6190
Error típico	0.1100	0.1481	0.4577	0.3967
Mediana	5.1100	5.3300	6.0700	6.4600
Moda	4.4800	#N/A	#N/A	#N/A
Desviación estándar	0.3478	0.4684	1.4473	1.2544
Varianza de la muestra	0.1210	0.2194	2.0948	1.5736
Curtosis	-0.9813	0.5336	-1.0842	0.5478
Coeficiente de asimetría	-0.5991	-0.8169	0.6330	0.8133
Rango	0.9600	1.5400	4.0100	4.1200
Mínimo	4.4800	4.3600	5.1000	5.0100
Máximo	5.4400	5.9000	9.1100	9.1300
Suma	50.1700	52.9600	65.5700	66.1900
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.2488	0.3351	1.0354	0.8974

Descriptive statistics of b *				
Media	17.8630	18.0200	15.6250	19.2280
Error típico	0.4223	0.4122	0.3379	0.2539
Mediana	17.5450	18.2000	15.9100	19.2550
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3355	1.3036	1.0684	0.8030
Varianza de la muestra	1.7834	1.6993	1.1415	0.6448
Curtosis	-1.0220	-0.0845	-0.1095	-0.7939
Coeficiente de asimetría	0.6003	-0.7594	-0.8875	0.1922
Rango	3.6800	4.0100	3.2200	2.5000
Mínimo	16.3600	15.6300	13.5300	18.0900
Máximo	20.0400	19.6400	16.7500	20.5900
Suma	178.6300	180.2000	156.2500	192.2800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9553	0.9325	0.7643	0.5744

Descriptive statistics of L *				
Media	75.4890	73.4650	69.9630	73.0180
Error típico	0.3680	0.2307	1.4558	0.9991
Mediana	75.7000	73.4900	70.4100	74.3750
Moda	#N/A	73.4400	#N/A	#N/A
Desviación estándar	1.1636	0.7294	4.6036	3.1595
Varianza de la muestra	1.3540	0.5321	21.1930	9.9828
Curtosis	-0.7791	0.2131	-2.1376	-0.2614
Coeficiente de asimetría	-0.1937	-0.0856	-0.1205	-0.9657
Rango	3.6800	2.5300	11.4300	9.4500
Mínimo	73.6400	72.2100	63.5500	66.9700
Máximo	77.3200	74.7400	74.9800	76.4200
Suma	754.8900	734.6500	699.6300	730.1800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8324	0.5218	3.2932	2.2602

BLEACHING A7	PERIPHERAL ZONE							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	5.52	6.24	7.27	6.29	10.63	10.28	9.35	5.93
2	7.48	6.4	6.38	8.46	9.53	11.94	5.83	7.12
3	7.66	6.9	6.24	7.81	11.13	11.36	6.54	6.52
4	7.6	7.37	6.52	7.82	9.86	10.34	6.34	6.66
5	7.51	6.31	6.7	8.68	9.66	10.13	7.24	6.42
6	5.95	6.83	7.28	8.2	8.75	9.50	7.38	6.26
7	6.98	6.94	7.02	7.94	8.53	8.82	7.22	6.63
8	6.11	7.2	7.34	7.04	8.23	9.60	6.84	6.26
9	6.4	7.41	7.05	8.16	8.18	10.29	8.00	5.71
10	6.58	8.17	6.88	7.03	9.03	10.21	8.37	5.56
AVERAGE	6.78	6.98	6.87	7.74	9.35	10.25	7.31	6.31

PERIPHERAL ZONE								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	16.03	15.47	17.03	18.17	18.55	21.18	18.71	18.68
2	23.8	15.47	18.78	17.76	20.73	22.67	19.18	
3	20.93	23.23	18.75	17.35	23.40	22.64	18.74	18.51
4	20.02	20.6	17.81	16.86	23.39	23.31	19.71	17.93
5	18.47	17.32	17.3	15.05	21.34	22.56	19.13	18.76
6	15.4	20.31	16.43	17.04	20.60	22.03	19.17	18.57
7	15.61	15.78	18.06	15.26	19.49	21.23	19.71	17.77
8	15.81	17.17	16.76	15.86	19.50	20.81	20.78	18.72
9	16.23	18.48	17.03	16.25	20.23	21.39	19.79	19.63
10	17.49	20.14	17.31	17.6	20.03	22.93	20.26	19.99
AVERAGE	17.98	18.40	17.53	16.72	20.73	22.08	19.52	18.73

PERIPHERAL ZONE								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	73.1	72.03	71.51	74.84	60.78	65.30	69.41	74.27
2	70.56	71.53	75.33	71.65	64.00	70.80	74.81	69.87
3	69.74	70.85	75.48	73.19	69.91	70.82	73.36	70.17
4	70.35	70.32	75.36	73.85	70.34	71.03	73.61	70.78
5	69.71	71.53	75.28	74.45	68.94	70.41	73.00	71.13
6	72.01	69.87	74.35	74.15	68.34	70.54	72.63	71.91
7	70.42	70.2	74.05	74.65	67.24	70.52	73.09	72.24
8	72.44	69.56	74.12	74.95	67.89	69.63	72.55	72.47
9	71.41	68.26	73.47	75.23	67.54	68.32	71.22	73.74
10	71.13	68.06	72.61	72.38	65.72	66.47	70.42	74.41
AVERAGE	71.09	70.22	74.16	73.93	67.07	69.38	72.41	72.10

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	-1.62244	-1.24284	1.02205	-1.96164	1.28032	0.03704	1.96160	-0.79794
x2	0.90336	-0.97302	-1.24070	0.96800	0.17746	1.90015	-1.42478	1.72076
x3	1.13532	-0.12985	-1.59663	0.09045	1.78162	1.24919	-0.74173	0.45083
x4	1.05800	0.66274	-0.88476	0.10395	0.50832	0.10438	-0.93414	0.74715
x5	0.94202	-1.12479	-0.42712	1.26501	0.30780	-0.13132	-0.06830	0.23917
x6	-1.06831	-0.24789	1.04747	0.61698	-0.60457	-0.83840	0.06638	-0.09948
x7	0.25902	-0.06239	0.38645	0.26596	-0.82514	-1.60161	-0.08755	0.68365
x8	-0.86212	0.37606	1.20002	-0.94909	-1.12592	-0.72617	-0.45312	-0.09948
x9	-0.48841	0.73019	0.46272	0.56298	-1.17605	0.04826	0.66284	-1.26359
x10	-0.25645	2.01181	0.03051	-0.96259	-0.32384	-0.04153	1.01880	-1.58107

b	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	-0.69360	-1.11913	-0.61710	1.35158	-1.35717	-1.03336	-1.22198	0.20462
x2	2.07154	-1.11913	1.56017	0.96941	0.00249	0.68698	-0.51117	-2.24528
x3	1.05019	1.84788	1.52285	0.58724	1.66777	0.65235	-1.17661	0.04863
x4	0.72634	0.84231	0.35334	0.13050	1.66153	1.42592	0.29037	-0.48356
x5	0.17473	-0.41179	-0.28118	-1.55665	0.38295	0.55998	-0.58679	0.27802
x6	-0.91780	0.73143	-1.36359	0.29828	-0.07859	-0.05196	-0.52630	0.10368
x7	-0.84307	-1.00060	0.66438	-1.36090	-0.77089	-0.97563	0.29037	-0.63037
x8	-0.77189	-0.46914	-0.95302	-0.80163	-0.76465	-1.46056	1.90858	0.24132
x9	-0.62242	0.03173	-0.61710	-0.43810	-0.30935	-0.79090	0.41136	1.07630
x10	-0.17402	0.66643	-0.26874	0.82027	-0.43409	0.98718	1.12216	1.40663

L	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
x1	1.75674	1.34914	-1.99978	0.76722	-2.17023	-2.01916	-1.86222	1.32100
x2	-0.45991	0.97625	0.88728	-1.93414	-1.05924	0.70008	1.48978	-1.35629
x3	-1.17552	0.46911	1.00065	-0.63004	0.97988	0.70997	0.58970	-1.17375
x4	-0.64318	0.07383	0.90995	-0.07113	1.12824	0.81379	0.74489	-0.80258
x5	-1.20170	0.97625	0.84949	0.43696	0.64520	0.50726	0.36624	-0.58961
x6	0.80550	-0.26177	0.14662	0.18291	0.43819	0.57154	0.13656	-0.11500
x7	-0.58209	-0.01566	-0.08011	0.60632	0.05865	0.56165	0.42210	0.08580
x8	1.18076	-0.49297	-0.02721	0.86037	0.28292	0.12162	0.08690	0.22574
x9	0.28188	-1.46251	-0.51846	1.09748	0.16216	-0.52605	-0.73868	0.99851
x10	0.03753	-1.61167	-1.16843	-1.31596	-0.46579	-1.44070	-1.23528	1.40619

Descriptive statistics of a *

Media	6.7790	6.9770	6.8680	7.7430	9.3530	10.2470	7.3110	6.3070
Error típico	0.2454	0.1875	0.1244	0.2342	0.3154	0.2818	0.3287	0.1494
Mediana	6.7800	6.9200	6.9500	7.8800	9.2800	10.2450	7.2300	6.3400
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.2600
Desviación estándar	0.7760	0.5930	0.3933	0.7407	0.9974	0.8910	1.0395	0.4725
Varianza de la muestra	0.6022	0.3516	0.1547	0.5486	0.9948	0.7938	1.0805	0.2232
Curtosis	-1.4545	0.4112	-1.2944	0.0622	-0.6361	0.6421	0.3103	-0.2915
Coeficiente de asimetría	-0.2814	0.6381	-0.3679	-0.8236	0.5624	0.5178	0.6510	-0.0754
Rango	2.1400	1.9300	1.1000	2.3900	2.9500	3.1200	3.5200	1.5600
Mínimo	5.5200	6.2400	6.2400	6.2900	8.1800	8.8200	5.8300	5.5600
Máximo	7.6600	8.1700	7.3400	8.6800	11.1300	11.9400	9.3500	7.1200
Suma	67.7900	69.7700	68.6800	77.4300	93.5300	102.4700	73.1100	63.0700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.5551	0.4242	0.2814	0.5299	0.7135	0.6374	0.7436	0.3380

Descriptive statistics of b *

Media	17.9790	18.3970	17.5260	16.7200	20.7260	22.0750	19.5180	18.4570
Error típico	0.8886	0.8271	0.2542	0.3393	0.5070	0.2739	0.2091	0.3446
Mediana	16.8600	17.9000	17.3050	16.9500	20.4150	22.2950	19.4450	18.6250
Moda	#N/A	15.4700	17.0300	#N/A	#N/A	#N/A	19.7100	#N/A
Desviación estándar	2.8100	2.6154	0.8038	1.0728	1.6033	0.8661	0.6612	1.0898
Varianza de la muestra	7.8960	6.8405	0.6460	1.1509	2.5707	0.7501	0.4372	1.1878
Curtosis	0.4324	-0.6588	-0.8260	-1.1633	-0.0808	-1.5949	-0.1253	2.4037
Coeficiente de asimetría	1.1145	0.5023	0.5214	-0.3790	0.8007	-0.1394	0.6318	-1.0566
Rango	8.4000	7.7600	2.3500	3.1200	4.8500	2.5000	2.0700	3.9800
Mínimo	15.4000	15.4700	16.4300	15.0500	18.5500	20.8100	18.7100	16.0100
Máximo	23.8000	23.2300	18.7800	18.1700	23.4000	23.3100	20.7800	19.9900
Suma	179.7900	183.9700	175.2600	167.2000	207.2600	220.7500	195.1800	184.5700
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.0101	1.8710	0.5750	0.7674	1.1470	0.6196	0.4730	0.7796

Descriptive statistics of L*

Media	71.0870	70.2210	74.1560	73.9340	67.0700	69.3840	72.4100	72.0990
Error típico	0.3624	0.4240	0.4184	0.3734	0.9165	0.6396	0.5094	0.5197
Mediana	70.8450	70.2600	74.2350	74.3000	67.7150	70.4650	72.8150	72.0750
Desviación estándar	1.1459	1.3408	1.3231	1.1809	2.8983	2.0226	1.6110	1.6434
Varianza de la muestra	1.3130	1.7979	1.7507	1.3945	8.4002	4.0910	2.5952	2.7009
Curtosis	-0.7990	-0.7242	0.1913	-0.0465	1.3896	0.5086	0.0383	-1.3340
Coeficiente de asimetría	0.5128	-0.4211	-0.9253	-0.9781	-1.2159	-1.3378	-0.6519	0.1747
Rango	3.3900	3.9700	3.9700	3.5800	9.5600	5.7300	5.4000	4.5400
Mínimo	69.7100	68.0600	71.5100	71.6500	60.7800	65.3000	69.4100	69.8700
Máximo	73.1000	72.0300	75.4800	75.2300	70.3400	71.0300	74.8100	74.4100
Suma	710.8700	702.2100	741.5600	739.3400	670.7000	693.8400	724.1000	720.9900
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.8197	0.9592	0.9465	0.8448	2.0733	1.4469	1.1524	1.1757

CENTRAL ZONE														
POLISH B5	0				b					0				
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	7.23	8.30	8.88	8.45	1	11.33	11.52	8.67	8.92	1	65.27	65.38	62.99	63.11
2	8.88	6.17	8.78	9.74	2	10.99	17.46	10.81	8.56	2	65.69	67.02	64.53	62.00
3	6.10	6.72	8.92	9.86	3	17.40	18.28	9.01	9.07	3	65.74	65.84	63.86	61.45
4	6.75	9.02	9.31	9.60	4	17.01	11.38	9.09	9.33	4	64.48	65.71	63.32	63.61
5	5.69	8.00	8.66	8.71	5	19.70	12.45	9.42	7.88	5	66.14	64.69	63.68	64.69
6	6.33	7.58	9.70	9.37	6	17.99	14.44	7.32	7.88	6	65.61	64.69	63.79	62.99
7	7.46	6.76	9.14	9.71	7	16.20	16.22	8.01	9.42	7	64.69	65.01	62.72	61.88
8	7.31	6.67	9.09	9.25	8	15.49	15.85	8.54	10.74	8	63.21	65.51	63.11	62.38
9	6.35	5.92	8.51	8.99	9	17.35	19.06	9.56	10.85	9	63.85	67.52	65.35	61.55
10	8.04	6.11	9.39	9.27	10	14.76	19.32	8.41	9.60	10	63.75	66.78	63.21	62.07
AVERAGE	7.01	7.13	9.04	9.30	**AVERAGE**	15.82	15.60	8.88	9.23	**AVERAGE**	64.84	65.82	63.66	62.57

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	0.22312	1.12357	-0.43703	-1.82000
x2	1.92752	-0.91320	-0.71363	0.95846
x3	-0.94414	-0.38727	-0.32639	1.21692
x4	-0.27270	1.81205	0.75235	0.65692
x5	-1.36765	0.83670	-1.04555	-1.26000
x6	-0.70655	0.43508	1.83109	0.16154
x7	0.46070	-0.34902	0.28213	0.89385
x8	0.30576	-0.43508	0.14383	-0.09692
x9	-0.68589	-1.15225	-1.46044	-0.65692
x10	1.05983	-0.97057	0.97363	-0.05385

b	Z1	Z2	Z3	Z4
x1	-1.60063	-1.34593	-0.22543	-0.29999
x2	-1.72178	0.61455	2.02883	-0.65409
x3	0.56229	0.88518	0.13273	-0.15246
x4	0.42332	-1.39213	0.21700	0.10328
x5	1.38185	-1.03898	0.56462	-1.32293
x6	0.77252	-0.38219	-1.64750	-1.32293
x7	0.13469	0.20529	-0.92066	0.19180
x8	-0.11830	0.08317	-0.36237	1.49014
x9	0.54447	1.14262	0.71209	1.59833
x10	-0.37842	1.22843	-0.49931	0.36885

L	Z1	Z2	Z3	Z4
x1	0.42754	-0.44083	-0.84256	0.52473
x2	0.84806	1.22115	1.10571	-0.55991
x3	0.89813	0.02534	0.25808	-1.09734
x4	-0.36346	-0.10641	-0.42508	1.01331
x5	1.29863	-1.14008	0.03036	2.06863
x6	0.76796	-1.14008	0.16952	0.40747
x7	-0.15319	-0.81579	-1.18414	-0.67717
x8	-1.63505	-0.30909	-0.69075	-0.18859
x9	-0.99425	1.72786	2.14309	-0.99963
x10	-1.09437	0.97794	-0.56424	-0.49151

Descriptive statistics of a *				
Media	7.0140	7.1250	9.0380	9.2950
Error típico	0.3061	0.3307	0.1143	0.1468
Mediana	6.9900	6.7400	9.0050	9.3200
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.9681	1.0458	0.3615	0.4643
Varianza de la muestra	0.9372	1.0937	0.1307	0.2156
Curtosis	0.0020	-0.7774	-0.2974	-0.5109
Coeficiente de asimetría	0.6103	0.6455	0.3853	-0.6429
Rango	3.1900	3.1000	1.1900	1.4100
Mínimo	5.6900	5.9200	8.5100	8.4500
Máximo	8.8800	9.0200	9.7000	9.8600
Suma	70.1400	71.2500	90.3800	92.9500
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6925	0.7481	0.2586	0.3321

Descriptive statistics of b				
Media	15.8220	15.5980	8.8840	9.2250
Error típico	0.8875	0.9581	0.3002	0.3215
Mediana	16.6050	16.0350	8.8400	9.2000
Moda	#N/A	#N/A	#N/A	7.8800
Desviación estándar	2.8064	3.0299	0.9493	1.0167
Varianza de la muestra	7.8758	9.1802	0.9012	1.0336
Curtosis	-0.0624	-1.5098	1.2200	-0.4556
Coeficiente de asimetría	-0.7978	-0.2824	0.4818	0.3485
Rango	8.7100	7.9400	3.4900	2.9700
Mínimo	10.9900	11.3800	7.3200	7.8800
Máximo	19.7000	19.3200	10.8100	10.8500
Suma	158.2200	155.9800	88.8400	92.2500
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.0076	2.1674	0.6791	0.7273

Descriptive statistics of L				
Media	64.8430	65.8150	63.6560	62.5730
Error típico	0.3158	0.3120	0.2500	0.3236
Mediana	64.9800	65.6100	63.5000	62.2250
Moda	#N/A	64.6900	#N/A	#N/A
Desviación estándar	0.9987	0.9868	0.7904	1.0234
Varianza de la muestra	0.9975	0.9737	0.6248	1.0473
Curtosis	-1.2903	-0.8646	1.2101	0.5248
Coeficiente de asimetría	-0.3695	0.5961	1.1628	0.9962
Rango	2.9300	2.8300	2.6300	3.2400
Mínimo	63.2100	64.6900	62.7200	61.4500
Máximo	66.1400	67.5200	65.3500	64.6900
Suma	648.4300	658.1500	636.5600	625.7300
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.7145	0.7059	0.5655	0.7321

POLISH B5	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	7.42	11.68	7.28	10.53	10.34	10.07	11.50	9.32
2	10.23	10.58	7.69	8.9	9.66	10.26	9.52	8.65
3	10.87	10.16	8.16	9.97	11.47	11.88	11.09	8.32
4	7.02	7.08	10.04	11.28	11.93	11.72	9.51	8.22
5	8.76	8.3	9.29	9.72	11.07	10.21	10.70	7.29
6	9.95	9.27	9.65	9.92	10.65	9.58	10.52	7.41
7	11.03	9.5	10.31	10.7	10.38	10.83	10.70	8.82
8	10.44	9.58	8.19	9.69	10.11	11.81	10.73	8.93
9	9.5	8.86	8.9	9.34	10.72	11.19	10.92	10.35
10	10.09	11.4	11.42	10.76	11.00	10.33	11.49	9.34
AVERAGE	9.53	9.64	9.09	10.08	10.73	10.79	10.67	8.67

	PZ							
	b							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	14.98	8.12	17.32	8.06	8.79	9.39	9.07	12.41
2	10.52	8.91	17.32	9.6	9.10	9.44	10.77	15.26
3	11.64	11.85	16.23	7.81		11.88	10.16	14.19
4	15.96	14.53	9.67	5.07	10.05	11.83	10.23	14.74
5	10.97	15.72	11.25	7.4	10.93	9.72	9.05	17.13
6	8.44	13.72	11.03	6.75	10.46	10.37	8.50	16.17
7	8.11	12.14	12.1	6.91	10.02	10.81	8.98	16.03
8	8.44	13.91	15.2	7.76	9.69	11.69	9.05	16.22
9	9.34	13.79	13.53	8.74	10.34	10.24	9.27	13.20
10	8.63	10.86	16.8	5.41	9.48	10.22	7.49	13.94
AVERAGE	10.70	12.36	14.05	7.35	9.87	10.56	9.26	14.93

	PZ							
	L							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	64.19	64.21	66.07	62.38	61.02	63.41	60.14	60.23
2	62.21	64.31	64.07	62.56	63.21	62.37	62.58	62.77
3	61.4	63.73	65.91	62.11	64.61	60.21	60.95	61.79
4		64.78	61.97	61.74	62.92	61.06	62.80	61.99
5	63.41	67.11	66.21	62.21	62.91	64.44	57.52	64.30
6	61.33	67.24	65.69	62.2	64.69	64.09	59.89	62.98
7	61.03	68.11	63.04	61.47	65.39	62.92	58.76	61.90
8	60.55	66.87	65.23	64.2	65.38	63.02	59.79	62.22
9	64.42	63.91	60.69	63.47	63.30	62.39	59.51	61.09
10	61.05	64.33		62.2	64.52	62.69	56.95	58.81
AVERAGE	62.18	65.46	64.32	62.45	63.80	62.66	59.89	61.81

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-1.52704	1.46095	-1.39874	0.61813	-0.59050	-0.87454	1.20422	0.71273
x2	0.50564	0.67280	-1.08242	-1.62586	-1.61224	-0.64312	-1.66159	-0.01632
x3	0.96859	0.37187	-0.71982	-0.15281	1.10738	1.33009	0.61079	-0.37541
x4	-1.81638	-1.83497	0.73062	1.65064	1.79856	1.13520	-1.67606	-0.48422
x5	-0.55772	-0.96083	0.15199	-0.49698	0.50636	-0.70402	0.04632	-1.49619
x6	0.30309	-0.26582	0.42973	-0.22165	-0.12471	-1.47138	-0.21421	-1.36561
x7	1.08433	-0.10103	0.93892	0.85217	-0.53040	0.05116	0.04632	0.16866
x8	0.65754	-0.04371	-0.69667	-0.53828	-0.93609	1.24482	0.08974	0.28836
x9	-0.02242	-0.55959	-0.14890	-1.02012	-0.01953	0.48965	0.36474	1.83351
x10	0.40436	1.26033	1.79530	0.93477	0.40118	-0.55786	1.18974	0.73449

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	1.53324	-1.71730	1.13268	0.50996	-1.19607	-1.21894	-0.19904	-1.67860
x2	-0.06560	-1.39696	1.13268	1.61763	-0.92932	-1.16680	1.61040	0.22057
x3	0.33590	-0.20478	0.75569	0.33014	2.37492	1.37743	0.96113	-0.49245
x4	1.88456	0.88197	-1.51312	-1.64065	-0.11186	1.32529	1.03564	-0.12595
x5	0.09572	1.36452	-0.96667	0.03524	0.64536	-0.87484	-0.22033	1.46669
x6	-0.81125	0.55351	-1.04276	-0.43228	0.24093	-0.19707	-0.80573	0.82697
x7	-0.92955	-0.08718	-0.67269	-0.31720	-0.13768	0.26172	-0.29483	0.73368
x8	-0.81125	0.63056	0.39946	0.29418	-0.42163	1.17931	-0.22033	0.86029
x9	-0.48862	0.58190	-0.17812	0.99906	0.13768	-0.33263	0.01384	-1.15216
x10	-0.74314	-0.60623	0.95283	-1.39610	-0.60234	-0.35348	-1.88076	-0.65905

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.67535	-0.75118	0.27166	-0.09153	-2.02604	0.58698	0.13192	-1.04014
x2	-0.22999	-0.69109	-0.33472	0.13111	-0.42711	-0.22696	1.41431	0.63410
x3	-0.60036	-1.03964	0.22315	-0.42550	0.59504	-1.91746	0.55763	-0.01186
x4	2.20712	-0.40864	-0.97142	-0.88316	-0.63884	-1.25222	1.52994	0.11997
x5	0.31870	0.99156	0.31411	-0.30181	-0.64614	1.39309	-1.24508	1.64261
x6	-0.63237	1.06969	0.15645	-0.31418	0.65344	1.11917	0.00053	0.77253
x7	-0.76954	1.59251	-0.64701	-1.21713	1.16452	0.20349	-0.59337	0.06064
x8	-0.98902	0.84734	0.01698	2.15967	1.15722	0.28175	-0.05203	0.27157
x9	0.78052	-0.93147	-1.35951	1.25671	-0.36140	-0.21131	-0.19919	-0.47327
x10	-0.76040	-0.67907	2.33032	-0.31418	0.52933	0.02348	-1.54465	-1.97614

Descriptive statistics of a *

Media	9.5310	9.6410	9.0930	10.0810	10.7330	10.7880	10.6680	8.6650
Error típico	0.4372	0.4413	0.4099	0.2297	0.2105	0.2596	0.2185	0.2906
Mediana	10.0200	9.5400	9.0950	9.9450	10.6850	10.5800	10.7150	8.7350
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	10.7000	#N/A
Desviación estándar	1.3824	1.3957	1.2962	0.7264	0.6655	0.8210	0.6909	0.9190
Varianza de la muestra	1.9111	1.9479	1.6800	0.5276	0.4429	0.6740	0.4774	0.8446
Curtosis	-0.1991	-0.0625	-0.5875	-0.6117	-0.0212	-1.4944	-0.0223	0.1180
Coeficiente de asimetría	-0.9772	-0.2479	0.3289	0.0717	0.2781	0.1694	-0.7775	0.1234
Rango	4.0100	4.6000	4.1400	2.3800	2.2700	2.3000	1.9900	3.0600
Mínimo	7.0200	7.0800	7.2800	8.9000	9.6600	9.5800	9.5100	7.2900
Máximo	11.0300	11.6800	11.4200	11.2800	11.9300	11.8800	11.5000	10.3500
Suma	95.3100	96.4100	90.9300	100.8100	107.3300	107.8800	106.6800	86.6500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9889	0.9984	0.9272	0.5196	0.4761	0.5873	0.4942	0.6574

Descriptive statistics of b *

Media	10.7030	12.3550	14.0450	7.3510	10.1800	10.5590	9.2570	14.9290
Error típico	0.8821	0.7798	0.9143	0.4397	0.3675	0.3033	0.2971	0.4745
Mediana	9.9300	12.9300	14.3650	7.5800	10.0350	10.3050	9.0600	15.0000
Moda	8.4400	#N/A	17.3200	#N/A	#N/A	#N/A	9.0500	#N/A
Desviación estándar	2.7895	2.4661	2.8914	1.3903	1.1621	0.9590	0.9395	1.5007
Varianza de la muestra	7.7814	6.0815	8.3601	1.9329	1.3506	0.9197	0.8827	2.2520
Curtosis	0.0536	-0.6113	-1.7266	-0.1881	3.2878	-1.4365	0.3918	-0.8724
Coeficiente de asimetría	1.1025	-0.5804	-0.2146	-0.2536	1.5096	0.3391	-0.1466	-0.2644
Rango	7.8500	7.6000	7.6500	4.5300	4.1500	2.4900	3.2800	4.7200
Mínimo	8.1100	8.1200	9.6700	5.0700	8.7900	9.3900	7.4900	12.4100
Máximo	15.9600	15.7200	17.3200	9.6000	12.9400	11.8800	10.7700	17.1300
Suma	107.0300	123.5500	140.4500	73.5100	101.8000	105.5900	92.5700	149.2900
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9955	1.7641	2.0684	0.9946	0.8313	0.6861	0.6721	1.0735

Descriptive statistics of L *

Media	62.7130	65.4600	65.1740	62.4540	63.7950	62.6600	59.8890	61.8080
Error típico	0.6916	0.5262	1.0430	0.2557	0.4331	0.4041	0.6017	0.4797
Mediana	61.8050	64.5550	65.4600	62.2050	63.9100	62.8050	59.8400	61.9450
Moda	#N/A	#N/A	#N/A	62.2000	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.1870	1.6640	3.2983	0.8085	1.3697	1.2777	1.9027	1.5171
Varianza de la muestra	4.7830	2.7690	10.8785	0.6536	1.8760	1.6326	3.6202	2.3016
Curtosis	1.3908	-1.7352	3.0818	1.5781	0.3007	0.3408	-0.4547	0.9586
Coeficiente de asimetría	1.2810	0.5248	1.2476	1.3057	-0.7230	-0.6522	0.1046	-0.5248
Rango	6.9900	4.3800	12.1700	2.7300	4.3700	4.2300	5.8500	5.4900
Mínimo	60.5500	63.7300	60.6900	61.4700	61.0200	60.2100	56.9500	58.8100
Máximo	67.5400	68.1100	72.8600	64.2000	65.3900	64.4400	62.8000	64.3000
Suma	627.1300	654.6000	651.7400	624.5400	637.9500	626.6000	598.8900	618.0800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.5645	1.1904	2.3594	0.5783	0.9798	0.9140	1.3611	1.0853

CENTRAL ZONE														
DYE B4	a					b					L			
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	7.67	7.25	8.49	5.69	1	7.21	7.34	4.73	7.74	1	47.64	46.53	47.65	51.52
2	6.64	6.04	11.19	7.83	2	5.57	7.12	5.84	8.25	2	48.78	48.67	37.86	48.14
3	9.13	6.72	8.62	8.24	3	6.34	6.61	7.92	6.04	3		45.50	47.51	46.12
4	5.54		8.36	6.37	4		6.58	9.39	8.02	4	51.08		45.99	50.74
5	6.64	7.59	7.77	6.43	5	7.05	6.23	8.68		5	49.61	45.21	48.76	52.02
6	6.93	6.67	6.95	7.17	6	6.29	5.98	6.97	8.23	6	49.21	48.59	52.45	51.59
7	7.03	6.67	6.16	7.69	7	6.24	5.91	8.31	6.96	7	48.74	48.51	50.85	47.49
8	7.56	6.34	9.14	6.95	8	5.74	6.41	7.39	8.13	8	48.00	48.37	44.57	49.13
9	7.11	7.48	8.75	6.94	9	6.13		6.91	7.42	9	47.90	47.66	45.16	51.45
10	6.15	6.59	9.69	6.53	10	7.28	6.18	7.17	7.56	10	50.56	47.49	41.44	51.88
AVERAGE	7.04	6.82	8.51	6.98	**AVERAGE**	6.43	6.48	7.33	7.59	**AVERAGE**	49.06	47.39	46.22	50.01

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	0.65155	0.09478	-0.01575	-1.67150
x2	-0.41368	-0.96711	1.91678	1.09280
x3	2.16148	-0.37034	0.07730	1.62241
x4	-1.55130	2.56959	-0.10879	-0.79312
x5	-0.41368	0.39316	-0.53109	-0.71562
x6	-0.11376	-0.41422	-1.11800	0.24026
x7	-0.01034	-0.41422	-1.68344	0.91196
x8	0.53778	-0.70383	0.44949	-0.04392
x9	0.07239	0.29663	0.17035	-0.05684
x10	-0.92044	-0.48443	0.84315	-0.58645

B	Z1	Z2	Z3	Z4
x1	0.60954	1.37977	-1.91001	-0.12971
x2	-1.17874	1.08957	-1.09489	0.31132
x3	-0.33912	0.41683	0.43252	-1.59982
x4	2.19065	0.37726	1.51200	0.11242
x5	0.43508	-0.08442	0.99062	2.30028
x6	-0.39364	-0.41419	-0.26510	0.29402
x7	-0.44816	-0.50653	0.71891	-0.80423
x8	-0.99337	0.15301	0.04333	0.20754
x9	-0.56811	-2.26092	-0.30916	-0.40644
x10	0.68587	-0.15038	-0.11823	-0.28537

L	Z1	Z2	Z3	Z4
x1	-0.42988	-0.09348	0.33099	0.71124
x2	0.12828	0.80361	-1.94140	-0.87870
x3	-2.37852	-0.52526	0.29850	-1.82890
x4	1.25438	-2.41167	-0.05431	0.34433
x5	0.53465	-0.64683	0.58864	0.94644
x6	0.33881	0.77008	1.44514	0.74417
x7	0.10869	0.73654	1.07376	-1.18446
x8	-0.25362	0.67785	-0.38392	-0.41301
x9	-0.30258	0.38022	-0.24697	0.67831
x10	0.99978	0.30895	-1.11043	0.88058

Descriptive statistics of a *				
Media	7.0400	7.1420	8.5120	6.9840
Error típico	0.3058	0.3603	0.4418	0.2448
Mediana	6.9800	6.6950	8.5550	6.9450
Moda	6.6400	6.6700	#N/A	#N/A
Desviación estándar	0.9669	1.1395	1.3971	0.7742
Varianza de la muestra	0.9350	1.2984	1.9520	0.5993
Curtosis	1.9157	5.4563	0.8375	-0.4910
Coeficiente de asimetría	0.8159	2.1520	0.1970	0.0848
Rango	3.5900	4.0300	5.0300	2.5500
Mínimo	5.5400	6.0400	6.1600	5.6900
Máximo	9.1300	10.0700	11.1900	8.2400
Suma	70.4000	71.4200	85.1200	69.8400
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6917	0.8151	0.9995	0.5538

Descriptive statistics of b *				
Media	6.6510	6.2940	7.3310	7.8900
Error típico	0.2900	0.2397	0.4306	0.3657
Mediana	6.3150	6.3200	7.2800	7.8800
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.9171	0.7581	1.3618	1.1564
Varianza de la muestra	0.8410	0.5747	1.8544	1.3372
Curtosis	1.4469	2.4943	0.2990	3.3039
Coeficiente de asimetría	1.1324	-1.0712	-0.4790	1.0458
Rango	3.0900	2.7600	4.6600	4.5100
Mínimo	5.5700	4.5800	4.7300	6.0400
Máximo	8.6600	7.3400	9.3900	10.5500
Suma	66.5100	62.9400	73.3100	78.9000
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.6560	0.5423	0.9742	0.8272

Descriptive statistics of L *				
Media	48.5180	46.7530	46.2240	50.0080
Error típico	0.6459	0.7544	1.3624	0.6723
Mediana	48.7600	47.5750	46.7500	51.0950
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.0424	2.3855	4.3082	2.1259
Varianza de la muestra	4.1716	5.6905	18.5608	4.5193
Curtosis	3.4355	3.3833	0.3712	-0.8530
Coeficiente de asimetría	-1.4460	-1.7600	-0.5882	-0.8157
Rango	7.4200	7.6700	14.5900	5.9000
Mínimo	43.6600	41.0000	37.8600	46.1200
Máximo	51.0800	48.6700	52.4500	52.0200
Suma	485.1800	467.5300	462.2400	500.0800
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.4611	1.7065	3.0819	1.5208

DYE B4	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	9.2	6.62	10.35	12.33	8.53	6.55	9.92	10.38
2	9.88	12.92	13.51	11.88	7.80	9.20	9.73	9.59
3	11.46	10.2	10.26	9.7	11.30	9.66	11.97	13.33
4	8.02	8.06	11.95	9.91	13.08	7.28	6.82	12.81
5	9.63	7.01	11.55	10.39	9.64	7.30	8.94	12.88
6	9.9	8.32	9.64	12.75	9.01	8.38	9.53	11.85
7	6.1	12.43	10.25	11.96	11.18	8.63	9.57	10.16
8	7.64	10.97	14.08	13.34	10.45	8.98	8.12	9.48
9	7.52	10	12.9	14.27	12.64	8.95	8.21	9.24
10	9	8.03	12.75	12.88	12.45	8.01	9.07	10.86
AVERAGE	8.84	9.46	11.72	11.94	10.61	8.29	9.19	11.06

PZ								
b								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	5.25	6.69	4.46	3.83	9.53	10.85	9.50	6.46
2	8.96	4.74	3.41	6	9.87	11.23	5.57	7.25
3	8.09	7.84	6.34	9.49	10.94	8.31	6.85	6.42
4	4.39	4.76	1.5	8.65	7.66	9.97	11.13	6.60
5	6.11	5.45	3.74	8.66	9.01	9.91	9.18	7.07
6	6.14	7.17	6.36	2.34	8.31	10.10	9.59	7.51
7	8.06	3.55	5.79	4.78	9.65	9.49	8.97	6.08
8	6.92	4.94	2.59	-0.32	8.94	9.33	7.59	5.71
9	6.74	4.15	3.54	-1.64		9.51	7.70	6.67
10	5.66	4.7	2.33	4.19	8.28	9.73	8.33	5.38
AVERAGE	6.63	5.40	4.01	4.60	9.13	9.84	8.44	6.52

PZ								
L								
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	43.76	48.73	38.9	35.62	46.80	52.77	45.55	42.60
2	42.83	36.21	33.69	37.28	49.55	48.01	42.96	42.76
3	39.55	40.75	39.06	41.5	42.21	47.14	41.79	40.76
4	48.07	45.33	35.16	40.69	38.76	50.45	48.07	40.17
5	42.14	50.08	35.61	38.37	44.40	51.57	46.95	38.54
6	42.27	45.21	39.29	32.32	47.87	48.94	45.40	39.21
7	48.68	35.81	38.93	32.49	45.07	48.10	45.47	42.56
8	47.85	38.17	32.3	32.78	41.80	48.49	46.59	43.17
9	47.24	40.2	32.68	31.01	41.20	48.56	47.01	44.75
10	45.51	45.33	32.88	35.34	40.18	50.81	45.34	41.28
AVERAGE	44.79	42.58	35.85	35.74	43.78	49.48	45.51	41.58

STATISTICAL TREATMENT

Grubs tests

a	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.23776	-1.29319	-0.88275	0.25696	-1.13519	-1.75907	0.53879	-0.43934
x2	0.68070	1.57955	1.14744	-0.04029	-1.53399	0.91383	0.39894	-0.95125
x3	1.70990	0.33926	-0.94057	-1.48033	0.37803	1.37780	2.04771	1.47224
x4	-0.53088	-0.63656	0.14520	-1.34161	1.35043	-1.02276	-1.74298	1.13528
x5	0.51785	-1.11535	-0.11179	-1.02454	-0.52881	-1.00259	-0.18254	1.18064
x6	0.69373	-0.51801	-1.33889	0.53440	-0.87297	0.08674	0.25173	0.51321
x7	-1.78155	1.35612	-0.94699	0.01255	0.31248	0.33890	0.28117	-0.58190
x8	-0.77841	0.69037	1.51365	0.92413	-0.08631	0.69193	-0.78611	-1.02253
x9	-0.85658	0.24806	0.75554	1.53846	1.11006	0.66167	-0.71986	-1.17805
x10	0.10748	-0.65024	0.65917	0.62027	1.00627	-0.28645	-0.08685	-0.12830

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.97519	0.93157	0.26652	-0.20380	0.50426	1.24520	0.66891	-0.08243
x2	1.64273	-0.47553	-0.34988	0.37205	0.71489	1.71509	-1.81345	1.10153
x3	1.02882	1.76139	1.37018	1.29819	1.37774	-1.89563	-1.00494	-0.14237
x4	-1.58204	-0.46109	-1.47116	1.07528	-0.65418	0.15704	1.69849	0.12739
x5	-0.36834	0.03680	-0.15616	1.07793	0.18213	0.08285	0.46678	0.83177
x6	-0.34717	1.27793	1.38192	-0.59920	-0.25151	0.31779	0.72576	1.49119
x7	1.00765	-1.33421	1.04730	0.04830	0.57860	-0.43650	0.33414	-0.65193
x8	0.20322	-0.33121	-0.83127	-1.30509	0.13876	-0.63435	-0.53753	-1.20644
x9	0.07621	-0.90126	-0.27357	-1.65537	-2.32059	-0.41177	-0.46805	0.23230
x10	-0.68588	-0.50439	-0.98390	-0.10827	-0.27010	-0.13973	-0.07011	-1.70100

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	-0.33032	1.21356	1.03871	-0.01010	0.82413	1.81314	0.01949	0.52806
x2	-0.62857	-1.25778	-0.73561	0.12959	1.57557	-0.81332	-1.34496	0.61090
x3	-1.68046	-0.36162	1.09320	0.48470	-0.43010	-1.29336	-1.96133	-0.42452
x4	1.05189	0.54243	-0.23499	0.41654	-1.37281	0.53302	1.34706	-0.72997
x5	-0.84985	1.48004	-0.08173	0.22131	0.16832	1.15100	0.75703	-1.57384
x6	-0.80816	0.51875	1.17153	-0.28779	1.11650	-0.30017	-0.05953	-1.22697
x7	1.24752	-1.33674	1.04893	-0.27348	0.35140	-0.76366	-0.02265	0.50736
x8	0.98134	-0.87089	-1.20899	-0.24908	-0.54213	-0.54847	0.56738	0.82316
x9	0.78571	-0.47019	-1.07958	-0.39803	-0.70608	-0.50984	0.78864	1.64114
x10	0.23090	0.54243	-1.01147	-0.03366	-0.98480	0.73166	-0.09114	-0.15531

Descriptive statistics of a *

Media	8.8350	9.4560	11.7240	11.9410	10.6080	8.2940	9.1880	11.0580
Error típico	0.4855	0.6935	0.4922	0.4787	0.5789	0.3135	0.4296	0.4880
Mediana	9.1000	9.1600	11.7500	12.1450	10.8150	8.5050	9.3000	10.6200
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.5352	2.1930	1.5565	1.5139	1.8305	0.9914	1.3586	1.5432
Varianza de la muestra	2.3568	4.8094	2.4227	2.2917	3.3508	0.9829	1.8458	2.3816
Curtosis	0.0538	-1.1505	-1.5226	-0.9107	-1.3369	-0.7552	1.6808	-1.6413
Coeficiente de asimetría	-0.1531	0.3606	0.1290	-0.2633	-0.1323	-0.4868	0.3727	0.3592
Rango	5.3600	6.3000	4.4400	4.5700	5.2800	3.1100	5.1500	4.0900
Mínimo	6.1000	6.6200	9.6400	9.7000	7.8000	6.5500	6.8200	9.2400
Máximo	11.4600	12.9200	14.0800	14.2700	13.0800	9.6600	11.9700	13.3300
Suma	88.3500	94.5600	117.2400	119.4100	106.0800	82.9400	91.8800	110.5800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0982	1.5688	1.1135	1.0829	1.3095	0.7092	0.9719	1.1040

Descriptive statistics of b *

Media	6.6320	5.3990	4.0060	4.5980	8.7160	9.8430	8.4410	6.5150
Error típico	0.4481	0.4382	0.5387	1.1917	0.5105	0.2557	0.5006	0.2110
Mediana	6.4400	4.8500	3.6400	4.4850	8.9750	9.8200	8.6500	6.5300
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.4172	1.3858	1.7034	3.7683	1.6142	0.8087	1.5832	0.6673
Varianza de la muestra	2.0083	1.9205	2.9016	14.2004	2.6058	0.6540	2.5064	0.4452
Curtosis	-0.6599	-0.6186	-1.1747	-0.8282	2.9143	0.9441	0.2061	-0.5046
Coeficiente de asimetría	0.1739	0.6782	0.2224	-0.3123	-1.3196	-0.0292	-0.2106	-0.2383
Rango	4.5700	4.2900	4.8600	11.1300	5.9700	2.9200	5.5600	2.1300
Mínimo	4.3900	3.5500	1.5000	-1.6400	4.9700	8.3100	5.5700	5.3800
Máximo	8.9600	7.8400	6.3600	9.4900	10.9400	11.2300	11.1300	7.5100
Suma	66.3200	53.9900	40.0600	45.9800	87.1600	98.4300	84.4100	65.1500
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.0138	0.9914	1.2186	2.6957	1.1548	0.5785	1.1325	0.4773

Descriptive statistics of L *

Media	44.7900	42.5820	35.8500	32.1780	35.7400	49.4840	45.5130	41.5800
Error típico	0.9861	1.6020	0.9285	3.7579	1.1573	0.5731	0.6003	0.6108
Mediana	44.6350	42.9800	35.3850	34.0600	35.4800	48.7500	45.5100	41.9200
Moda	#N/A	45.3300	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	3.1182	5.0661	2.9363	11.8837	3.6596	1.8123	1.8982	1.9316
Varianza de la muestra	9.7231	25.6651	8.6220	141.2212	13.3929	3.2845	3.6032	3.7310
Curtosis	-1.2731	-1.3820	-2.0424	7.5581	-1.1996	-0.7006	0.5020	-0.6911
Coeficiente de asimetría	-0.2255	0.0414	0.0996	-2.6061	0.3629	0.6329	-0.8927	-0.1015
Rango	9.1300	14.2700	6.9900	41.5000	10.4900	5.6300	6.2800	6.2100
Mínimo	39.5500	35.8100	32.3000	0.0000	31.0100	47.1400	41.7900	38.5400
Máximo	48.6800	50.0800	39.2900	41.5000	41.5000	52.7700	48.0700	44.7500
Suma	447.9000	425.8200	358.5000	321.7800	357.4000	494.8400	455.1300	415.8000
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.2306	3.6240	2.1005	8.5011	2.6179	1.2965	1.3579	1.3818

CENTRAL ZONE														
BLEACHING B9	a				b					L				
	Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4		Z1	Z2	Z3	Z4
1	9.58	10.42	10.19	7.57	1	4.20	4.01	2.96	5.61	1	43.04	41.20	42.29	46.99
2	9.14	6.36	7.86	9.11	2	3.30	10.68	4.48	3.10	2	44.10	49.08	47.44	44.50
3		6.90	10.97	8.58	3	9.89	11.75	2.68	3.48	3		47.60	41.16	44.43
4	8.68	10.80	7.87		4	9.00	3.69	4.35	6.67	4	44.54	41.46	49.38	48.25
5	9.23	8.47	7.88	8.21	5	6.64	7.84	4.58	3.83	5	42.54	44.56	46.72	46.04
6	8.28	9.06	9.62	7.82	6	7.17	7.65	3.83	3.53	6	45.16	43.94	44.39	47.04
7	8.84	9.97	7.38	7.66	7	5.32	4.87	4.58	4.47	7	43.00	42.14	48.25	46.62
8	9.41	10.01	7.12	8.01	8	5.73	3.88	5.49	3.72	8	42.98	43.89	47.95	45.93
9	9.34	9.35	7.44	8.53	9	7.91	5.58	5.18	2.64	9	43.47	43.73	46.85	45.69
10	8.46	7.70	9.49	8.48	10	8.11	8.65	3.46	2.62	10	44.72	46.23	43.60	45.18
AVERAGE	9.00	8.90	8.58	8.22	**AVERAGE**	6.73	6.86	4.16	3.97	**AVERAGE**	43.73	44.38	45.80	46.07

STATISTICAL TREATMENT

Grubs tests

a	Z1	Z2	Z3	Z4
x1	1.10141	1.00200	1.18409	-0.62635
x2	0.45868	-1.68146	-0.53166	1.43912
x3	-2.22911	-1.32454	1.75846	0.72828
x4	-0.21327	1.25316	-0.52430	-2.19556
x5	0.59014	-0.28685	-0.51694	0.23203
x6	-0.79757	0.10311	0.76436	-0.29104
x7	0.02045	0.70457	-0.88512	-0.50564
x8	0.85308	0.73101	-1.07658	-0.03621
x9	0.75083	0.29478	-0.84094	0.66122
x10	-0.53463	-0.79578	0.66863	0.59416

b	Z1	Z2	Z3	Z4
x1	-1.20181	-0.98112	-1.31083	1.26871
x2	-1.62984	1.31504	0.35094	-0.66949
x3	1.50428	1.68339	-1.61694	-0.37606
x4	1.08101	-1.09128	0.20881	2.08723
x5	-0.04138	0.33737	0.46027	-0.10579
x6	0.21068	0.27196	-0.35969	-0.33745
x7	-0.66915	-0.68506	0.46027	0.38841
x8	-0.47416	-1.02587	1.45514	-0.19073
x9	0.56262	-0.44064	1.11623	-1.02470
x10	0.65774	0.61621	-0.76419	-1.04014

L	Z1	Z2	Z3	Z4
x1	-0.74881	-1.22842	-1.27098	0.76936
x2	0.03243	1.81272	0.59226	-1.30616
x3	2.17714	1.24154	-1.67981	-1.36450
x4	0.35671	-1.12808	1.29414	1.81962
x5	-1.11731	0.06831	0.33176	-0.02251
x6	0.81366	-0.17097	-0.51121	0.81103
x7	-0.77829	-0.86564	0.88531	0.46095
x8	-0.79303	-0.19026	0.77677	-0.11419
x9	-0.43189	-0.25201	0.37880	-0.31424
x10	0.48938	0.71282	-0.79703	-0.73935

Descriptive statistics of a *				
Media	8.8260	8.9040	8.5820	8.0370
Error típico	0.2165	0.4784	0.4294	0.2358
Mediana	8.9900	9.2050	7.8750	8.1100
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	0.6846	1.5130	1.3580	0.7456
Varianza de la muestra	0.4686	2.2891	1.8442	0.5559
Curtosis	1.6983	-0.9578	-1.1194	1.8488
Coeficiente de asimetría	-1.2589	-0.5367	0.6770	-0.9868
Rango	2.2800	4.4400	3.8500	2.7100
Mínimo	7.3000	6.3600	7.1200	6.4000
Máximo	9.5800	10.8000	10.9700	9.1100
Suma	88.2600	89.0400	85.8200	80.3700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.4897	1.0823	0.9715	0.5334

Descriptive statistics of b *				
Media	6.7270	6.8600	4.1590	3.9670
Error típico	0.6649	0.9186	0.2892	0.4095
Mediana	6.9050	6.6150	4.4150	3.6250
Moda	#N/A	#N/A	4.5800	#N/A
Desviación estándar	2.1027	2.9049	0.9147	1.2950
Varianza de la muestra	4.4212	8.4382	0.8367	1.6771
Curtosis	-0.8104	-1.0886	-0.7842	0.9209
Coeficiente de asimetría	-0.1850	0.5009	-0.3130	1.1934
Rango	6.5900	8.0600	2.8100	4.0500
Mínimo	3.3000	3.6900	2.6800	2.6200
Máximo	9.8900	11.7500	5.4900	6.6700
Suma	67.2700	68.6000	41.5900	39.6700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.5042	2.0780	0.6543	0.9264

Descriptive statistics of L *				
Media	44.0560	44.3830	45.8030	46.0670
Error típico	0.4291	0.8194	0.8741	0.3794
Mediana	43.7850	43.9150	46.7850	45.9850
Moda	#N/A	#N/A	#N/A	#N/A
Desviación estándar	1.3568	2.5911	2.7640	1.1997
Varianza de la muestra	1.8410	6.7140	7.6397	1.4393
Curtosis	1.2587	-0.4334	-1.0693	-0.3067
Coeficiente de asimetría	1.1327	0.5926	-0.5284	0.2647
Rango	4.4700	7.8800	8.2200	3.8200
Mínimo	42.5400	41.2000	41.1600	44.4300
Máximo	47.0100	49.0800	49.3800	48.2500
Suma	440.5600	443.8300	458.0300	460.6700
Cuenta	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	0.9706	1.8536	1.9773	0.8582

BLEACHING B9	PZ							
	a							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	8.14	5.65	9.88	12.04	7.20	8.33	9.75	11.94
2	13.25	8.05	12.27	13.51	7.33	11.69	9.20	10.46
3	13.88	12.38	12.76	10.09	11.12	8.72	11.68	10.52
4	13.39	9.05	11.95	11.07	9.66	7.90	12.00	11.34
5	7.18	9.59	11.12	11.96	7.37	10.08	11.83	11.97
6	9.57	10.97	13.69	12.39	6.64	8.95	9.40	11.17
7	9.43	11.79	12.19	11.5	7.38	8.97	9.46	11.07
8	9.12	14.1	13.75	12.69	7.48	10.09	9.98	10.30
9	7.73	17.47	13.13	12.43	8.46	10.17	9.37	10.79
10	9.8	20.36	12.11	13.4	9.89	10.64	10.09	10.72
AVERAGE	10.15	11.94	12.29	12.11	8.25	9.55	10.28	11.03

	PZ							
	b							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	10.01	12.76	11.04	1.92	4.79	4.65	3.12	2.39
2	1.28	10.22	3.68	3.21	5.15	8.83	4.17	3.23
3	1.89	3.17	5.99	4.88	7.27	6.80		9.74
4	-0.71	6.09	9.23	3.06	6.41	5.74	3.50	7.76
5	9.65	6.94	6.69	1.9	7.29	6.46	2.57	5.52
6	7.52	6.29	6.48	0.53	6.68	4.53	4.03	5.76
7	5.88	3.19	4.15	6.36	6.83	5.53	3.37	4.95
8	6.35	1.63	2.71	3.18	8.60	4.67	3.10	5.90
9	8.35	-11.76	9.09	5.72	7.52	5.57	4.42	4.84
10	4.38	-9.68	9.26	4.38	8.55	7.99	3.91	2.93
AVERAGE	5.46	2.89	6.83	3.51	6.91	6.08	3.58	5.30

	PZ							
	L							
	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
1	45.62	50.04	43.81	37.01	52.44	46.88	44.54	39.96
2	42.6	46.5	39.43	39.38	50.45	45.88	42.81	42.64
3	40.17	41.1	39.21	44.64	46.34	49.37	41.15	39.77
4	41.44	46.2	41.8	43.7	48.40	46.41	42.09	39.59
5	47.45	45.74	42.6	39.47	50.21	45.13	41.08	39.05
6	46.49	44.07	40.42	36.93	52.72	47.28	42.95	40.54
7	46.08	42.08	38.72	42.89	52.18	47.45	43.71	41.50
8	45.82	38.96	38.62	40.13	52.71	47.75	42.97	40.95
9	48.53	41.96	39.86	38.84	52.38	46.78	43.13	41.28
10	45.78	43.11	42.57	39.53	50.46	45.57	42.68	42.16
AVERAGE	45.00	43.98	40.70	40.25	50.83	46.85	42.71	40.74

STATISTICAL TREATMENT

Grubs tests

x1	-0.81434	-1.42313	-2.05280	-0.06549	-0.71311	-1.04613	-0.47217	1.55380
x2	1.25698	-0.88021	-0.01280	1.35027	-0.62507	1.82560	-0.96589	-0.96772
x3	1.51235	0.09931	0.40544	-1.94355	1.94159	-0.71280	1.26032	-0.86550
x4	1.31373	-0.65399	-0.28594	-0.99970	0.95285	-1.41364	1.54757	0.53156
x5	-1.20347	-0.53184	-0.99439	-0.14254	-0.59799	0.44956	1.39497	1.60492
x6	-0.23470	-0.21966	1.19924	0.27160	-1.09236	-0.51623	-0.78635	0.24193
x7	-0.29144	-0.03416	-0.08109	-0.58557	-0.59121	-0.49913	-0.73249	0.07156
x8	-0.41710	0.48840	1.25046	0.56053	-0.52349	0.45811	-0.26571	-1.24032
x9	-0.98053	1.25075	0.72125	0.31012	0.14018	0.52648	-0.81328	-0.40549
x10	-0.14147	1.90452	-0.14937	1.24433	1.10861	0.92818	-0.16697	-0.52475

b	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	1.23950	1.24773	1.51511	-0.87246	-1.69336	-0.98246	-0.25015	-1.30100
x2	-1.13870	0.92680	-1.13489	-0.16639	-1.40567	1.89539	0.89682	-0.92571
x3	-0.97253	0.03601	-0.30317	0.74766	0.28849	0.49777	-2.23824	1.98277
x4	-1.68082	0.40496	0.86341	-0.24849	-0.39877	-0.23202	0.16495	1.09816
x5	1.14143	0.51236	-0.05113	-0.88340	0.30447	0.26369	-0.85094	0.09740
x6	0.56118	0.43023	-0.12674	-1.63325	-0.18300	-1.06508	0.74389	0.20462
x7	0.11442	0.03854	-0.96567	1.55772	-0.06313	-0.37660	0.02294	-0.15726
x8	0.24245	-0.15857	-1.48414	-0.18281	1.35133	-0.96870	-0.27200	0.26717
x9	0.78729	-1.85044	0.81300	1.20743	0.48827	-0.34906	1.16991	-0.20641
x10	-0.29421	-1.58762	0.87421	0.47399	1.31137	1.31707	0.61281	-1.05974

L	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ
x1	0.23096	1.88592	1.67755	-1.22004	0.75799	0.02455	1.72344	-0.67043
x2	-0.89041	0.78497	-0.68809	-0.32815	-0.17832	-0.79370	0.09329	1.62135
x3	-1.79270	-0.89444	-0.80691	1.65131	-2.11212	2.06197	-1.47091	-0.83291
x4	-1.32113	0.69167	0.59195	1.29757	-1.14287	-0.36003	-0.58516	-0.98683
x5	0.91046	0.54861	1.02403	-0.29429	-0.29125	-1.40738	-1.53686	-1.44861
x6	0.55400	0.02923	-0.15339	-1.25015	0.88973	0.35184	0.22521	-0.17445
x7	0.40176	-0.58966	-1.07156	0.99274	0.63566	0.49095	0.94134	0.64649
x8	0.30522	-1.55999	-1.12557	-0.04591	0.88503	0.73642	0.24405	0.17616
x9	1.31147	-0.62698	-0.45585	-0.53137	0.72976	-0.05728	0.39482	0.45836
x10	0.29037	-0.26933	1.00783	-0.27171	-0.17362	-1.04735	-0.02921	1.21088

Descriptive statistics of a *

Media	10.1490	11.9410	12.2850	12.1080	8.2530	9.5540	10.2760	11.0280
Error típico	0.7801	1.3979	0.3705	0.3283	0.4670	0.3700	0.3523	0.1856
Mediana	9.5000	11.3800	12.2300	12.2150	7.4300	9.5250	9.8650	10.9300
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.4670	4.4205	1.1716	1.0383	1.4766	1.1700	1.1140	0.5869
Varianza de la muestra	6.0862	19.5412	1.3726	1.0781	2.1804	1.3690	1.2410	0.3445
Curtosis	-1.2381	0.1629	0.8014	0.2921	-0.2565	-0.4993	-1.2665	-0.7481
Coeficiente de asimetría	0.6074	0.6913	-0.7693	-0.5458	0.9827	0.3643	0.8300	0.6078
Rango	6.7000	14.7100	3.8700	3.4200	4.4800	3.7900	2.8000	1.6700
Mínimo	7.1800	5.6500	9.8800	10.0900	6.6400	7.9000	9.2000	10.3000
Máximo	13.8800	20.3600	13.7500	13.5100	11.1200	11.6900	12.0000	11.9700
Suma	101.4900	119.4100	122.8500	121.0800	82.5300	95.5400	102.7600	110.2800
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.7648	3.1623	0.8381	0.7428	1.0563	0.8370	0.7969	0.4199

Descriptive statistics of b *

Media	5.4600	2.8850	6.8320	3.5140	6.9090	6.0770	3.3490	5.3020
Error típico	1.1608	2.5027	0.8783	0.5778	0.3957	0.4593	0.2895	0.7078
Mediana	6.1150	4.6400	6.5850	3.1950	7.0500	5.6550	3.4350	5.2350
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	3.6708	7.9143	2.7774	1.8270	1.2514	1.4525	0.9155	2.2383
Varianza de la muestra	13.4750	62.6368	7.7137	3.3380	1.5659	2.1097	0.8381	5.0099
Curtosis	-1.0416	0.3248	-1.2324	-0.6975	-0.2978	-0.1666	1.9026	0.4143
Coeficiente de asimetría	-0.4303	-1.0170	-0.0464	0.0456	-0.3905	0.8419	-1.2356	0.6875
Rango	10.7200	24.5200	8.3300	5.8300	3.8100	4.3000	3.1200	7.3500
Mínimo	-0.7100	-11.7600	2.7100	0.5300	4.7900	4.5300	1.3000	2.3900
Máximo	10.0100	12.7600	11.0400	6.3600	8.6000	8.8300	4.4200	9.7400
Suma	54.6000	28.8500	68.3200	35.1400	69.0900	60.7700	33.4900	53.0200
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	2.6260	5.6616	1.9868	1.3070	0.8952	1.0390	0.6549	1.6012

Descriptive statistics of L *

Media	44.9980	43.9760	40.7040	40.2520	50.8290	46.8500	42.7110	40.7440
Error típico	0.8516	1.0168	0.5855	0.8403	0.6721	0.3865	0.3356	0.3698
Mediana	45.8000	43.5900	40.1400	39.5000	51.3200	46.8300	42.8800	40.7450
Moda	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Desviación estándar	2.6932	3.2154	1.8515	2.6573	2.1254	1.2221	1.0613	1.1694
Varianza de la muestra	7.2531	10.3389	3.4281	7.0612	4.5171	1.4936	1.1263	1.3675
Curtosis	-0.4571	0.0677	-1.3298	-0.8463	0.8187	0.8955	0.0291	-0.9965
Coeficiente de asimetría	-0.7587	0.3756	0.4750	0.5090	-1.1767	0.6729	-0.1349	0.2117
Rango	8.3600	11.0800	5.1900	7.7100	6.3800	4.2400	3.4600	3.5900
Mínimo	40.1700	38.9600	38.6200	36.9300	46.3400	45.1300	41.0800	39.0500
Máximo	48.5300	50.0400	43.8100	44.6400	52.7200	49.3700	44.5400	42.6400
Suma	449.9800	439.7600	407.0400	402.5200	508.2900	468.5000	427.1100	407.4400
Cuenta	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Nivel de confianza(95.0%)	1.9266	2.3002	1.3245	1.9009	1.5204	0.8743	0.7592	0.8365

imspector VIS & VNIR

SPECIM ImSpectors are designed for the VIS (380 - 800nm) and VNIR (400 - 1000nm) wavelength ranges. These spectrographs provide a straightforward, high performance, yet cost-effective method of integration. When combined with scientific grayscale CCD or CMOS cameras the combination provides a line-scan Spectral Imaging device.

Visible wavelength range

ImSpector	V8 1/2" detector	V8 2/3" detector	V8E
Optical characteristics			
Spectral range	380 - 800 nm *1	380 - 800 nm *1	380 - 800 nm *1
Dispersion	93.6 nm/mm	66nm/mm	65nm/mm
Spectral resolution	8nm (with 80µm slit) *2	6nm (with 80µm slit) *2	2nm (with 30µm slit) *2
Image size	4.3 (spectral) x 6.6 (spatial) mm corresponding to standard 1/2" image sensor	6.6 (spectral) x 8.8 (spatial) mm corresponding to standard 2/3" image sensor	6.15 (spectral) x 14.2 (spatial) mm
Spatial resolution	rms spot radius < 30µm	rms spot radius < 30µm	rms spot radius < 9µm *2
Aberrations	Insignificant astigmatism		No astigmatism
Bending of spectral lines across spatial axis	Smile < 30µm	Smile < 45µm	Smile < 1.5µm
Bending of spatial lines across spectral axis	Keystone < 20µm	Keystone < 40µm	Keystone < 1µm
Numerical aperture	F/2.8		F/2.4
Slit width, default	50µm (30, 80 and 150µm on request)		30µm (18, 50, 80 and 150µm)
Slit length	9.6mm		14.2mm
Efficiency	> 50%, independent of polarization		
Stray light	< 0.5% (halogen lamp, 633nm long-pass filter)		
Mechanical characteristics			
Size	(D) 35 x (L) 139mm		(W) 60 x (H) x 60 x (L) 175mm
Weight	300g		1100g
Body	Anonized aluminium tube		
Lens and camera mount	Standard C-mount adapter		
User adjustments	Image axis relative to detector rows, adjustable back focal length ±1mm		
Environmental characteristics			
Storage	-20 ... +85 °C		
Operating	+5 ... +40 °C, non-condensing		

*1 Order blocking filter is available for mounting in front of the detector window.

*2 System spectral and spatial resolutions also depend on the discrete imaging nature of detector and objective lens quality.

ImSpector V8/V10 spectrograph, side view

ImSpector V8/V10 spectrograph, front view

ImSpector V8E/V10E spectrograph, side view

ImSpector V8E/V10E spectrograph, front view

Spectral Imaging Ltd.
POB 110
Teknologiantie 18 A
FIN–90571 Oulu, Finland

Tel. +358 (0)10 4244 400
Fax +358 (0)8 388 580
Email info@specim.fi
www.specim.fi

Visible near infrared wavelength range

ImSpector	V10 1/2" detector	V10 2/3" detector	V10E
Optical characteristics			
Spectral range	400 - 1000 nm *1	400 - 1000 nm *1	400 - 1000 nm *1
Dispersion	139 nm/mm	93.9 nm/mm	97.5 nm/mm
Spectral resolution	11.2 nm (with 80µm slit) *2	9nm (with 80µm slit) *2	2.8nm (with 30µm slit) *2
Image size	4.3 (spectral) x 6.6 (spatial) mm, corresponding to standard 1/2" image sensor	6.6 (spectral) x 8.8 (spatial) mm, corresponding to standard 2/3" image sensor	max 6.15 (spectral) x 14.2 (spatial) mm
Spatial resolution	rms spot radius < 40 µm	rms spot radius < 40 µm	rms spot radius < 9 µm
Aberrations	Insignificant astigmatism		No astigmatism
Bending of spectral lines across spatial axis	Smile < 30µm	Smile < 45µm	Smile < 1.5µm
Bending of spatial lines across spectral axis	Keystone < 20µm	Keystone <40µm	Keystone < 1µm
Numerical aperture	F/2.8		F/2.4
Slit width, default	50µm (30, 80 and 150µm)		30µm (13, 18, 50, 80 and 150µm)
Slit length	9.8mm		14.2
Optical input	N/A		Telecentric
Efficiency	> 50%, independent of polarization		
Stray ligth	< 0.5% (halogen lamp, 633nm notch filter)		
Mechanical characteristics			
Size, OEM	(D) 35 x (L) 139mm		(W) 60 x (H) x 60 x 175mm
Weight	300g		1100g
Body, OEM	Anonized aluminium tube		
Lens and camera mount	Standard C-mount adapter		
User adjustments	Image axis relative to detector rows, back focal length adjustable ±1mm		
Environmental characteristics			
Storage	-20 ... +85 °C		
Operating	+5 ... +40 °C, non-condensing		

*1 Order blocking filter is available for mounting in front of the detector window.
*2 System spectral and spatial resolutions also depend on the discrete imaging nature of detector and objective lens quality.

Options, fore optics

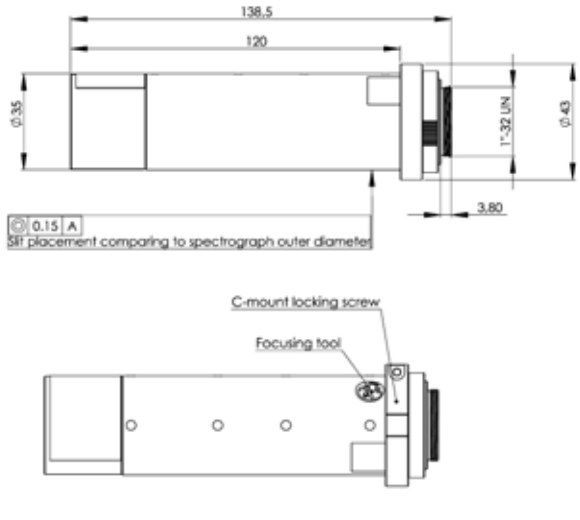
- Fore optics, Standard series: OL8, OL12, OL17, OL23 and OL35 for 2/3" or smaller detector
- Fore optics, Enhanced series: OLE9, OLE18.5, OLE23 and OLE140 for 2/3" or larger detector. Optimized for Enhanced series.

More information about fore optics can be found from the Hyperspectral fore lenses -data sheet.

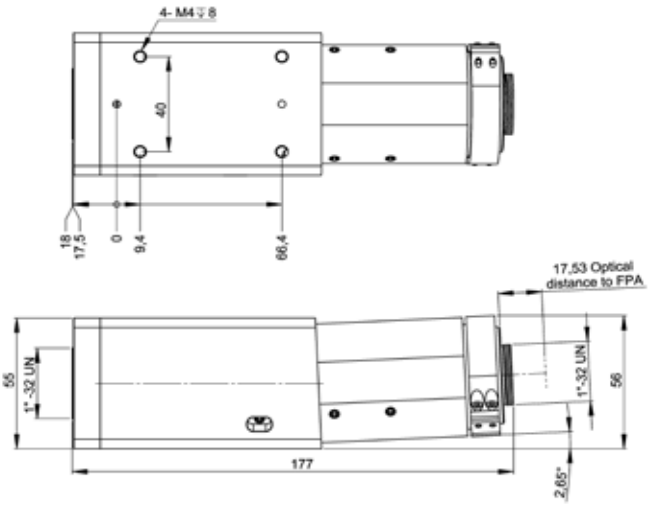
Options, accessories

- Mechanical shutter (Enhanced series)
- Collection fiber optics
- Order blocking filters; OBF 570 (rectangular 14 x 12mm or circular 20mm Ø and 17mm Ø) for V10 and V10E
- Fiber optic diffuse irradiance sensor (FODIS) for light source monitoring (Enhanced series)

More information about fiber optics can be found from Multipoint spectrometers -data sheet.



ImSpector V8/V10 mechanical dimensions



ImSpector V8E/V10E mechanical dimensions