ISSN 2410-3438

Volume 6, Issue 18 – January – June - 2019

Journal of Quantitative and Statistical Analysis

Journal of Quantitative and Statistical Analysis, Volume 6, Issue 18, January – June 2019, is a journal edited six-monthly by ECORFAN. 21 Santa Lucía, CP-5220. Libertadores -Sucre–Bolivia. WEB: www.ecorfan.org/spain, journal@ecorfan.org. Editor in Chief: MIRANDA - TORRADO, Fernando. PhD. ISSN-On line: 2410-3438. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda. PhD, LUNA-SOTO, Vladimir. PhD, last updated June 30, 2019.

Journal of Quantitative and Statistical Analysis

Definition of Journal

Scientific Objectives

Support the international scientific community in its written production Science, Technology and Innovation in the Field of Physical Sciences Mathematics and Earth sciences, in Subdisciplines of statistical analysis data analysis, multivariate analysis, statistic's and probability, statistical analytical, calculation.

ECORFAN-Mexico SC is a Scientific and Technological Company in contribution to the Human Resource training focused on the continuity in the critical analysis of International Research and is attached to CONACYT-RENIECYT number 1702902, its commitment is to disseminate research and contributions of the International Scientific Community, academic institutions, agencies and entities of the public and private sectors and contribute to the linking of researchers who carry out scientific activities, technological developments and training of specialized human resources with governments, companies and social organizations.

Encourage the interlocution of the International Scientific Community with other Study Centers in Mexico and abroad and promote a wide incorporation of academics, specialists and researchers to the publication in Science Structures of Autonomous Universities - State Public Universities - Federal IES - Polytechnic Universities - Technological Universities - Federal Technological Institutes - Normal Schools - Decentralized Technological Institutes - Intercultural Universities - S & T Councils - CONACYT Research Centers.

Scope, Coverage and Audience

Journal of Quantitative and Statistical Analysis is a Journal edited by ECORFAN-Mexico S.C in its Holding with repository in Bolivia, is a scientific publication arbitrated and indexed with semester periods. It supports a wide range of contents that are evaluated by academic peers by the Double-Blind method, around subjects related to the theory and practice of statistical analysis data analysis, multivariate analysis, statistic's and probability, statistical analytical, calculation with diverse approaches and perspectives, that contribute to the diffusion of the development of Science Technology and Innovation that allow the arguments related to the decision making and influence in the formulation of international policies in the Field of Physical Sciences Mathematics and Earth sciences. The editorial horizon of ECORFAN-Mexico® extends beyond the academy and integrates other segments of research and analysis outside the scope, as long as they meet the requirements of rigorous argumentative and scientific, as well as addressing issues of general and current interest of the International Scientific Society.

Arbitration Committee

Assignment of Rights

The sending of an Article to Journal of Quantitative and Statistical Analysis emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Originality Format for its Article.

The authors sign the Authorization Format for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Bolivia considers pertinent for disclosure and diffusion of its Article its Rights of Work.

Declaration of Authorship

Indicate the Name of Author and Coauthors at most in the participation of the Article and indicate in extensive the Institutional Affiliation indicating the Department.

Identify the Name of Author and Coauthors at most with the CVU Scholarship Number-PNPC or SNI-CONACYT- Indicating the Researcher Level and their Google Scholar Profile to verify their Citation Level and H index.

Identify the Name of Author and Coauthors at most in the Science and Technology Profiles widely accepted by the International Scientific Community ORC ID - Researcher ID Thomson - arXiv Author ID - PubMed Author ID - Open ID respectively.

Indicate the contact for correspondence to the Author (Mail and Telephone) and indicate the Researcher who contributes as the first Author of the Article.

Plagiarism Detection

All Articles will be tested by plagiarism software PLAGSCAN if a plagiarism level is detected Positive will not be sent to arbitration and will be rescinded of the reception of the Article notifying the Authors responsible, claiming that academic plagiarism is criminalized in the Penal Code.

Arbitration Process

All Articles will be evaluated by academic peers by the Double Blind method, the Arbitration Approval is a requirement for the Editorial Board to make a final decision that will be final in all cases. MARVID® is a derivative brand of ECORFAN® specialized in providing the expert evaluators all of them with Doctorate degree and distinction of International Researchers in the respective Councils of Science and Technology the counterpart of CONACYT for the chapters of America-Europe-Asia- Africa and Oceania. The identification of the authorship should only appear on a first removable page, in order to ensure that the Arbitration process is anonymous and covers the following stages: Identification of the Journal with its author occupation rate - Identification of Authors and Coauthors - Detection of plagiarism PLAGSCAN - Review of Formats of Authorization and Originality-Allocation to the Editorial Board-Allocation of the pair of Expert Arbitrators-Notification of Arbitration -Declaration of observations to the Author-Verification of Article Modified for Editing-Publication.

Instructions for Scientific, Technological and Innovation Publication

Knowledge Area

The works must be unpublished and refer to topics of statistical analysis data analysis, multivariate analysis, statistic’s and probability, statistical analytical, calculation and other topics related to Physical Sciences Mathematics and Earth sciences.

Presentation of the content

In the first article we present *Synthesis of polar copolymers by the process of emulsion via free radicals (FRP)* by MAGAÑA-MALDONADO, Luis Mario & CONTRERAS-LÓPEZ, David with adscription in the, Universidad de Guanajuato, in the next article we present *Influence of zinc oxide in a polar polymer matrix* by GAYTÁN-LARA, Francisco Javier, CONTRERAS-LÓPEZ, David and GALINDO-GONZÁLEZ, Rosario, in the next article we present *Obtaining conductive composites of PANI and thermoplastic polymers* by CONTRERAS-ZARAZÚA, Diana Nelly, CONTRERAS-LOPÉZ, David, FUENTES-RAMIREZ, Rosalba and GALINDO-GONZÁLEZ Rosario with adscription in the Universidad de Guanajuato in the next article we present *Impact of the Quality Costs applied in Automotive and Metal-Mechanical Manufacturing SMEs in the North of Aguascalientes. Municipality of Rincon de Romos* by VAZQUEZ-GUTIERREZ, Rosa Inés, FLORES-AGUILAR, Mauricio y NÚÑEZ-MONTALVO, Juan Manuel with adscription in the Universidad Tecnologica del Norte de Aguascalientes.

Content

Article **Journal of Quantitative and Statistical Analysis**
June, 2019 Vol.6 No.18 1-5

Synthesis of polar copolymers by the process of emulsion via free radicals (FRP)

Síntesis de copolímeros polares por el proceso de emulsión a través de radicales libres (FRP)

MAGAÑA-MALDONADO, Luis Mario† & CONTRERAS-LÓPEZ, David*

Universidad de Guanajuato

ID 1st Author: *Luis Mario, Magaña-Maldonado* / **ORC ID**: 0000-0001-9509-7631

ID 1st Coauthor: *David, Contreras-López* / **ORC ID**: 0000-0003-1384-4766, **CVU CONACYT ID:** 38297

Received January 22, 2019; Accepted March 25, 2019

Abstract

At present, the polymer industry has gained increasing importance due to the versatility of its properties, as well as the impact they have on the environment. The present investigation provides the determination of optimal operating conditions for the polymerization of styrene and vinyl propionate in a Batch reactor, as well as the copolymerization of styrene with propionate monomers by the process of emulsion via free radicals, allowing to observe the variations with respect to Reaction yields and molecular weights. Another important factor is the activation of the initiator so that the polymerization process begins within each of the micelles. Likewise, it was found that, in the copolymerizations, there are considerable variations with respect to reaction yields and molecular weights as the concentrations are modified. In addition, it was found that there are higher yields in styrene polymerizations per solution than emulsion.

Styrene, Vinyl propionate, Free radicals

Resumen

En la actualidad, la industria de los polímeros ha cobrado una creciente importancia debido a la versatilidad de sus propiedades, así como en el impacto que estos tienen con el ambiente. La presente investigación proporciona la determinación de condiciones de operación óptimas para la polimerización de estireno y de vinil propionato en un reactor Batch, así como la copolimerización de estireno con monómeros de propionato mediante el proceso de emulsión vía radicales libres, permitiendo observar las variaciones respecto a rendimientos de reacción y pesos moleculares. Otro factor importante es la activación del iniciador para que comience el proceso de polimerización dentro de cada una de las micelas. Así mismo, se encontró que, en las copolimerizaciones, hay variaciones considerables respecto a rendimientos de reacción y pesos moleculares en la medida que se modifican las concentraciones. A demás que se encontró que existen mayores rendimientos en polimerizaciones de estireno por solución que por emulsión esto debido principalmente a las técnicas de purificación utilizadas para cada caso.

Estireno, Vinil propionato, Radicales libres

Citation: MAGAÑA-MALDONADO, Luis Mario & CONTRERAS-LÓPEZ, David. Synthesis of polar copolymers by the process of emulsion via free radicals (FRP). Journal of Quantitative and Statistical Analysis. 2019 6-18: 1-5

* Correspondence to Author (email: david.contreras@ugto.mx)
† Researcher contributing as first author.

Introduction

Emulsion polymerization is widely used for the manufacture of several commercially important polymers. Many of these polymers are used as solid materials and must be isolated from the aqueous dispersion after polymerization. In other cases, the dispersion itself is the final product. A dispersion resulting from emulsion polymerization is often called latex. [1]

The latexes are used in a number of applications among which we can mention: adhesives, paints, paper and carpet coverings, fabric glues, printing inks, rubber products, cement reinforcement and in materials for immunodiagnostic tests. [2]

Emulsion polymerization is a type of radical polymerization involving a water-soluble initiator, a water-insoluble monomer and an emulsifier or surfactant (micelle-forming stabilizing agent). The main polymerization site is polymer particles (latex particles).

An emulsifier molecule (surfactant or emulsifier) consists of a long hydrophobic hydrocarbon chain with a hydrophilic end. By adding small amounts of emulsifier to the water, this is distributed between the aqueous phase where its molecules are individualized, and the interfaces of the system (adsorbed in the monomer droplets and / or in the polymer particles and / or in the liquid interface / gas). By increasing the amount of emulsifier its concentration in the water increases and above a certain value, the emulsifier molecules form aggregates called micelles. In them the hydrophobic group of the molecule is disposed oriented towards the interior and the hydrophilic group directed towards the aqueous phase.

The concentration of emulsifier to which micelles are formed corresponds to the saturation concentration of the emulsifier in water and is called critical micelle concentration (CMC). Its value depends on the nature of the emulsifier and the presence of electrolytes in the aqueous medium. By adding emulsifier over CMC; the apparent solubility of the monomer increases because it can be absorbed in the hydrophobic interior of the micelles. [3]

The initiators used in the emulsion polymerizations are normally soluble in the aqueous phase.

At the moment when the initiator is added, it starts to decompose and starts to generate free radicals at a speed that depends on its nature, the temperature of the system and the pH of the medium. Because the initiator composition usually acidifies the medium, it is necessary to add a buffer substance or buffer. At moderate and high temperatures (> 50 C), dissociative initiators such as persulfates are used. On the other hand, at low temperatures (-5 to 20 C) Redox-type initiators are used. [4]

In many industrial systems chain transfer agents (modifiers or regulators) are added which allow to control the molecular weight of the polymer chains produced throughout the reaction.

Monomers that are highly soluble in water or almost insoluble in water can not be polymerized by conventional conventional emulsion (in aqueous medium). In the case of soluble monomers, the polymerization in aqueous solution can occur simultaneously with the emulsion polymerization. [5]

Methodology

Reagents

Monomers: Styrene and Vinyl Propionate: with purity percentage> 98% (Sigma-Aldrich)
Washing: 0.1M Sodium Hydroxide
Distillation: Vinyl Propionate 96 ^{0}C
Surfactant: Sodium Dodecyl Sulfate (SDS).
Initiator: Benzoyl Peroxide and Potassium Persulfate: with a purity percentage of 97% (Sigma-Aldrich)
Solvent: Distilled water, methyl ethyl ketone (MEK) and Toluene.
Purification: 96% methanol and distilled wáter.

Polymerization of styrene by emulsion

The emulsion polymerization process was followed via FRP. The reaction was carried out in a 250 ml Batch reactor, using for the aqueous phase a constant volume of 150 ml of distilled water, with a concentration of Dodecyl Sulfate of 33.3 g / L, while for the dispersed phase a 20 ml volume of Styrene with 0.350 g of initiator (KPS). The synthesis was carried out at a stirring speed of 500 rpm at a temperature of 60 ± 2 ° C for 3 hours.

ISSN 2410-3438

Polymerization of styrene by solution

The polymerization process was followed by solution via FRP. The reaction was carried out in a 250 ml Batch reactor, using for the aqueous phase a volume of 150 ml of Toluene, while for the dispersed phase a volume of 20 ml of Styrene with 0.350 g of initiator (BPO) was added. The synthesis was carried out at a stirring speed of 500 rpm at a temperature of 60 ± 2 ° C for 3 hours.

Polymerization of Vinyl Propionate by solution

The polymerization process was followed by solution via FRP. The reaction was carried out in a 250 ml Batch reactor, using for the aqueous phase a volume of 150 ml of MEK, while for the dispersed phase a volume of 20 ml of Vinyl Propionate was added with 0.350 g of initiator (BPO). The synthesis was carried out at a stirring speed of 500 rpm at a temperature of 60 ± 2 ° C for 3 hours.

Polymerization of Vinyl Propionate by emulsion

The emulsion polymerization process was followed via FRP. The reaction was carried out in a 250 ml Batch reactor, using for the aqueous phase a volume of 150 ml of distilled water, with a concentration of

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

Copolymerization of Styrene-Vinyl Propionate

The polymerization process was followed by solution and by emulsion via FRP. The reaction was carried out in a 250 ml Batch reactor, using 150 ml of MEK for the solution case and 150 ml of distilled water, with a concentration of Dodecyl Sulfate of 33.3 g / L for the aqueous phase, while for the Dispersed phase was added a monomer mixture for both emulsion and solution; 15 ml of styrene with three variations of vinyl propionate in each reaction; 2: 1, 4: 1, 1: 1 percentage by weight with respect to styrene, adding to the BPO and KPS system for each case: 350 g, at T: 60 ° C.

The synthesis was carried out at a stirring speed of 500 rpm for 3 hours.

Polymer purification

For the polymers by emulsion, 0.5 g of Sodium Chloride is added, it is dissolved in the sample. The liquid is decanted to evaporate. Then add 10 ml of Toluene to dissolve and finally methanol is added at a ratio of 1: 1.5, decanting leaving the solid to dry at 40 °C.

For the polymers per solution, only wash with 80 ml of cold methanol to remove the solvent and let it dry at 40 °C.

Results

Reaction	Relationship MOL S-PV	Terms	%Solids
RXN 2 Solutión	PV	500 rpm, 60ºC, 0.35g BPO, 150 ml MEK	13 %
RXN 10 Solutión	S	500 rpm, 60ºC, 0.35g BPO, 150 ml Tolueno	12%
RXN 4 Solutión	4:1	500 rpm, 60ºC, 0.35g BPO, 150 ml MEK	12%
RXN 3 Solutión	2:1	500 rpm, 60ºC, 0.35g BPO, 150 ml MEK	14%
RXN 5 Solutión	1:1	500 rpm, 60ºC, 0.35g BPO, 150 ml MEK	18%

Table 1 Operating conditions for reactions in solution (S-Styrene, PV-Vinyl Propionate) of Figure 2

Reaction	Relationship MOL S-PV	Terms	%Solids
RXN 8 Emulsión	4:1	500 rpm, 60ºC, 0.35g KPS, 150 ml H20-D, 5g SDS	10%
RXN 7 Emulsión	2:1	500 rpm, 60ºC, 0.35g KPS, 150 ml H20-D, 5g SDS	11%
RXN 3 Emulsión	1:1	500 rpm, 60ºC, 0.35g KPS, 150 ml H20-D, 5g SDS	15%
RXN 1 Emulsión	S	500 rpm, 60ºC, 0.35g KPS, 150 ml H20-D, 5g SDS	10%
RXN 6 Emulsión	PV	500 rpm, 60ºC, 0.35g KPS0, 150 ml H20-D, 5g SDS	11%

Table 2 Operating conditions for reactions in emulsion (S-Styrene, PV-Vinyl Propionate) of Figure 2

ISSN 2410-3438

In the experiment, 10 reactions were performed, which involved different volumes of Vinyl Propionate and Styrene according to molar ratios. The operating conditions to analyze or the effects on the polymerization were kept constant.

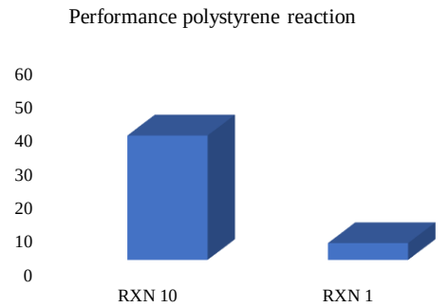


Figure 1 Performance graph of the polystyrene reaction, (RXN 10 per solution, RXN 1 emulsion)

In reactions where only styrene was used as a monomer, higher yields were obtained for solution polymerization than emulsion as shown in Figure 1, mainly because the solvent can affect the polymerized product in addition to the emulsion purification method is a little more rigorous, which reduces performance considerably

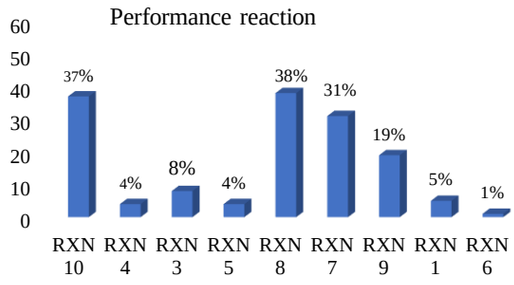


Figure 2 Performance graph of reactions by solution and emulsion

We see in figure 2 that the highest yields obtained are in the reactions where it involves the highest percentage in mol of styrene, except for the rxn 1 by emulsion since, because it is slightly soluble in water, so it tends to be lost the greater percentage in monomer solids during purification.

It is clear that, in emulsion copolymerizations, the yields decrease with the increase in vinyl monomer.

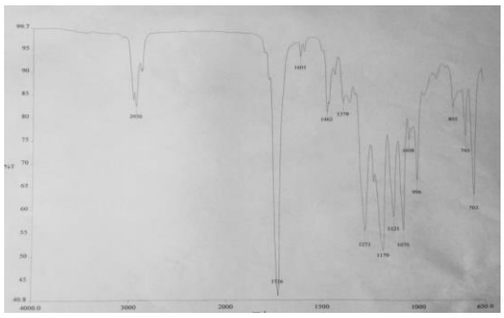


Figure 3 Infrared Spectrum of Vinyl Propionate per solution

Figure 3 shows the IR spectrum for the rxn 2, which is polymerized vinyl propionate, we can see the presence of some functional groups such as the methyl group in the signal of 2930, which confirms the signal of 1400 the presence of a CH group, as well as the presence of a C = O group in the 1726 signal, which belongs to an aldehyde confirmed by the signals between 1200 and 1000. The 700 signal indicates the presence of a propyl group. Therefore, the polymerization carried out can be checked.

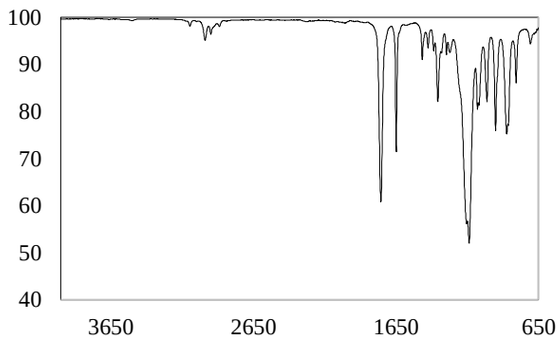


Figure 4 Infrared Spectrum of Distilled Monomer Vinyl Propionate

In Figure 4 it is possible to reaffirm the purification of the Vinyl monomer, achieving the elimination of its inhibitors, of which hydroquinones were mainly found as inhibitors. Therefore, no signal of any cyclic compound is seen in the spectrum.

Reactión	Mlecular Weight kg/mol (Mv)	Mlecular Weight kg/mol (MW)
RXN 10	2,582	3,098.9
RXN 4	978.6	1,174.4
RXN 3	256.7	308.1
RXN 5	2,520	3,024.1

Table 3 Comparative table of average molecular weights in weight by viscosimetry (at 25 ^{0}C)

ISSN 2410-3438

In table 2 it can be seen that a higher molecular weight was obtained for the reaction by solution where it only involves styrene, in the copolymerizations, with the percentage increase in monomer solids, the molecular weight decreases, at the moment they are equalized the molar quantities, the molecular weights increase.

Conclusions

It is important to mention that by emulsion, low conversions were obtained for the useful life of the initiator. This determines the initiation and propagation of the reaction since its function is to generate free radicals and, therefore, limits the conversion.

It was possible to synthesize copolymers by emulsion with higher yields with the decrease of concentrations of vinyl monomer. Furthermore, it is important to ensure the formation of an adequate micellar concentration to guarantee the appropriate reaction medium.

Finally, it could be noted that the yields of the styrene polymerizations are higher by solution polymerization than by emulsion, due to the type of purification that must be carried out for each of the different techniques

References

[1] Anderson D. (2000*) Emulsion Polymerisation and applications of latex.* Akron University. Ohio.

[2] Mendizabal. M. E. (2016*). Emulsiones, microemulsiones obtenidas mediante polimerización de monómeros.* Universidad de Guadalajara. Guadalajara

[3] Odian, G. (1991). *Principles of Polymerization* 3rd Ed., John Wiley and Sons, Inc., New York.

[4] L.M. Gungliotta (2015). *Polimerizacion de monómeros solubles en agua.* Universidad Nacional del Litoral. Argentina.

[5] L. M. Gungliotta. (2013). *Polimerizaciones Radicalarias Heterogéneas.* Universidad Nacional del Litoral. Argentina.

ISSN 2410-3438

Article **Journal of Quantitative and Statistical Analysis**
June, 2019 Vol.6 No.18 6-10

Influence of zinc oxide in a polar polymer matrix

Influencia de óxidos de zinc en una matriz polimérica polar

GAYTÁN-LARA, Francisco Javier†, CONTRERAS-LÓPEZ, David* and GALINDO-GONZÁLEZ, Rosario

ID 1st Author: *Francisco Javier, Gaytán-Lara*

ID 1st Coauthor: *David, Contreras-López* / **ORC ID**: 0000-0003-1384-4766, **CVU CONACYT ID:** 38297

ID 2nd Coauthor: *Rosario, Galindo-González* / **ORC ID:** 0000-0002-3612-1555**, CVU CONACYT ID:** 223987

Received January 05, 2019; Accepted April 01, 2019

Abstract

The creation of films constituted by semiconductor oxides of zinc oxide (ZnO) incorporated into a polar polymer matrix was proposed, looking for such films to be easy to apply, friendly to the environment and compatible with materials. Within the experimental process, the synthesis of styrene copolymers with a polar monomer (methyl methacrylate) was carried out through the suspension and emulsion polymerization processes.

Styrene, Suspension Polymerization, ZnO

Resumen

Se propuso la creación de películas constituidas por óxidos semiconductores de ZnO incorporados a una matriz polimérica polar, buscando que dichas películas sean de fácil aplicabilidad, amigables con el medio ambiente y compatibles con otros materiales y que se mejoren las propiedades conductoras. Dentro del proceso experimental, se llevó a cabo la síntesis de copolímeros de estireno con un monómero polar (metacrilato de metilo) mediante los procesos de polimerización en suspensión y emulsión.

Estireno, Polimerización en Suspensión, ZnO

Citation: GAYTÁN-LARA, Francisco Javier, CONTRERAS-LÓPEZ, David and GALINDO-GONZÁLEZ, Rosario. Influence of zinc oxide in a polar polymer matrix. Journal of Quantitative and Statistical Analysis. 2019 6-18: 6-10

* Correspondence to Author (email: david.contreras@ugto.mx)
† Researcher contributing as first author.

Introduction

The articles of common use suffer wear (yellowing) due to UV radiation, an alternative to this problem, consists of the use of coatings, which provide greater protection, without altering the intrinsic properties of the material on which it is applied. For the purposes of this experimental development, we propose the creation of films made of ZnO incorporated into a polar polymeric matrix, looking for such films to be easy to apply, friendly to the environment and compatible with materials that are applied.
Within the experimental process, the synthesis of styrene copolymers with a polar monomer (alkyl acrylate) will be carried out by means of the suspension and emulsion methods, then the synthesis of Zinc oxides will be carried out, which upon incorporation into the polymer matrix is expected to generate a synergy, potentiating the properties of resistance to yellowing of the composite.

Morphological, electrochemical and structural characterization tests will be carried out. The best particle-matrix weight ratio will be found to avoid yellowing of the films and the best matrix particle ratio will be determined when evaluating the dispersion of the oxides in the polymer matrix.

Polymers play an important role in the needs of human consumption today. That is why, for many years, science has worked on the modification of physical and chemical properties of these compounds, in order to produce diverse materials according to the application they require.

In the field of polymer production, we have been working on the search for synthesis processes that can improve the final properties of the polymer or improve the industrial production process. [I].

– **Suspension Polymerization**

In it, the polymerization occurs in the liquid phase in the monomer droplets (normally dispersed in water), using a soluble initiator in organic phase (azo- or peroxides) and a stabilization or suspension agent that does not form micelles (used to prevent the coalescence of the drops). The two-phase system is unstable, in the sense that polymerization in suspension is not maintained in the absence of agitation.

– **Emulsion polymerization**

The monomer is insoluble in the continuous medium and is suspended to form emulsion drops stabilized using surfactants (surfactants). The initiators used are soluble in water (or in the solvent). In such a way that the polymerization process does not occur in the drops, but in entities formed by the surfactant called micelles, which are fed by the monomer that travels by diffusion through the medium. [II].

Nanotechnology is an emerging interdisciplinary field that has become very popular in many areas over the last decade, including the science of materials, mechanics, electronics, optics, medicine, plastics, textiles, etc.). ZnO belongs to a group of metal oxides that are characterized by the following properties: photocatalytic capacity, electrical conductivity, UV absorption, photooxidant capacity against chemical products and biological species, antimicrobial and self-sterilization. In addition, ZnO is generally considered as a safe material for humans and animals, and has been widely used in the formulation of personal care products. [III].
ZnO) is a semiconductor that in nanoscale presents an ordered structure, and a great activation energy. The scientific interest in this material arose to recent dates, because it was observed that it is a solid with high mobility of electrons, good conductor of electricity, thermodynamically stable and capable of absorbing visible light.

The production of nanostructured fibers is an area where nanotechnology has had a great impact, since it presents the possibility of manufacturing antimicrobial textiles, which are very useful in the medical field, or the search for materials such as ZnO that, when irradiated by ultraviolet light, has an antibacterial effect [IV].
Inorganic ZnO semiconductor exists in two different phases such as zinc blend and hexagonal wurtzite. Among these, hexagonal wurtzite is the commonly observed structure at room temperature. [V].

This project aims to incorporate semiconductor oxide particles in a vinyl-type copolymer to achieve a good dispersion and to evaluate the synergy between the properties of the zinc oxide (ZnO) in combination with the polymers which will generate protective films against deterioration caused by the UV rays.

ISSN 2410-3438

Metodology

Synthesis of ZnO nanoparticles (wurzite) by the Sol-Gel method.

– **Synthesis of polymers**

Prior to any synthesis method, the ZnO nanoparticles were ground in an agatha mortar and the appropriate amount was weighed according to the desired incorporation either at 1% or 0.3% w/w, placing them in a flask with methanol immersed in a sonicator for 30 min.

– **Emulsion polymerization**

Prior to initiating the emulsion synthesis, of 0.68% Potassium Persulfate solution was prepared. A stirrer, distilled H_2O, sodium Dodecyl sulfate SDS (surfactant) was placed in a beaker and the stirring was started at the appropriate revolutions (rpm) according to the polymer to be obtained as well as the heating in order to reach the desired temperature. Once the reaction temperature was reached, the nanoparticles were added in case of being a polymer with incorporation of nanoparticles. Next, 0.68% potassium persulfate (used as initiator) and then monomer (s) used were added and then left for the appropriate time for the monomer (s) polymerization.

Suspension polymerization

A stirrer, the desired continuous medium as well as its dispersing medium was placed in a beaker, stirring and heating was carried out in order to reach the necessary reaction conditions for each polymer.

Once the reaction temperature was reached, the nanoparticles were added in case of being a polymer with incorporation of nanoparticles. Next, 0.68% potassium persulfate (used as initiator) and then monomer (s) used were added and then left for the appropriate time for the polymerization of each monomer (s). At the end of the reaction, 2 washes were made with tap water and one with distilled water.

The polymer is dried in an oven at 70 ° C for 24h. The polymers obtained are listed in table 1.

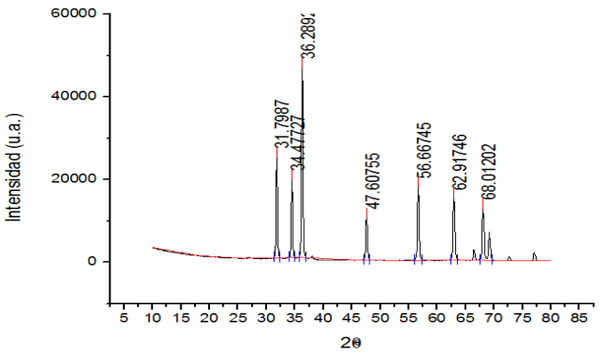
Polymer	Meth.	Monómer ml.	C.M. mL	Disp.	Initiator	ZnO (%)	T °C	Stir rpm	Time hours
PS	Em.		H_2O	SDS 0.225g	$K_2S_2O_8$ (0.68%) 2mL	0	85	00	3
PS	Em.		H_2O	SDS 0.225g	$K_2S_2O_8$ (0.68%) 2mL	1	85	00	3
PS	Em.		H_2O	SDS 0.225g	$K_2S_2O_8$ (0.68%) 2mL g	0.3	85	00	3
PS	Susp.		H_2O	PVA 0.075g	PBO 0.0181g	0	85	50	3
PS	Susp.		H_2O	PVA 0.075g	PBO 0.0181g	1	85	50	3
PS	Susp.		H_2O	PVA 0.075g	PBO 0.0181g	0.3	85	50	3
PMMA	Susp.		Gly 40	Cell. 0.15g	PBO 0.0181g	0	75	80	3
PMMA	Susp.		Gly 40	Cell. 0.15g	PBO 0.0181g	1	75	80	3
PMMA	Susp.		Gly 40	Cell. 0.15g	PBO 0.0181g	0.3	75	80	3
PS - PMMA 50 - 50 %	Susp.	03/0.9	Gly 40	Cell. 0.15g	PBO 0.0181g	0	75	80	3
PS - PMMA 50 - 50 %	Susp.	03/0.9	Gly 40	Cell. 0.15g	PBO 0.0181g	1	75	80	3
PS - PMMA 50 - 50 %	Susp.	03/0.9	Gly 40	Cell. 0.15g	PBO 0.0181g	0.3	75	80	3

Table 1 PS = Polystyrene, PMMA = Polymethylmethacrylate, SDS = Sodium Dodecyl Sulfate $NaC_{12}H_{25}SO_4$, PVA = Polyvinyl Alcohol (C_2H_4O) x, PBO = Benzoyl Peroxide $C_{14}H_{10}O_4$, $K_2S_2O_8$ = Potassium Persulfate

Results

Characterization of ZnO

XRD

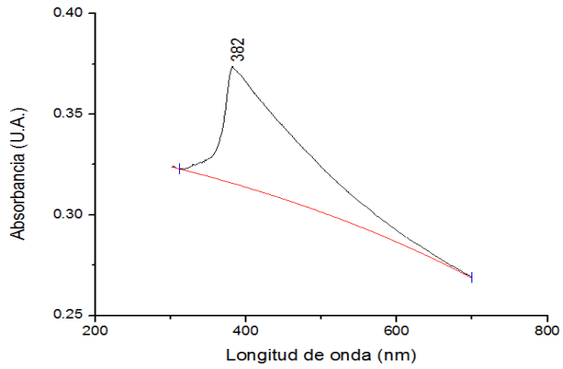


ZnO diffractogram synthesized via sol-gel

With these results the hexagonal wurzite phase is confirmed whose characteristic peaks are located at 32.24 ° (31.79 °), 34.42 ° (34.47 °), 36.25 ° (36.28 °), 47.54 ° (47.60 °), 56.84 ° (56.66 °), 62.86 (62.91), and 68.76 ° (68.01 °).

ISSN 2410-3438

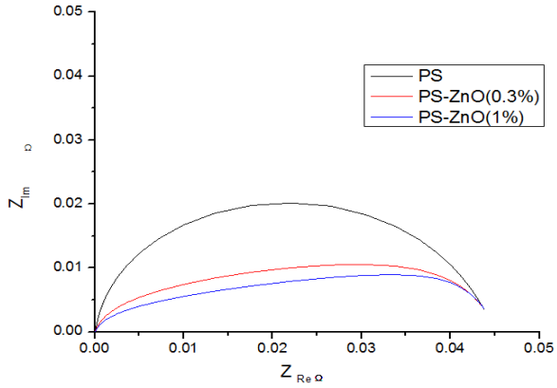
UV-Vis



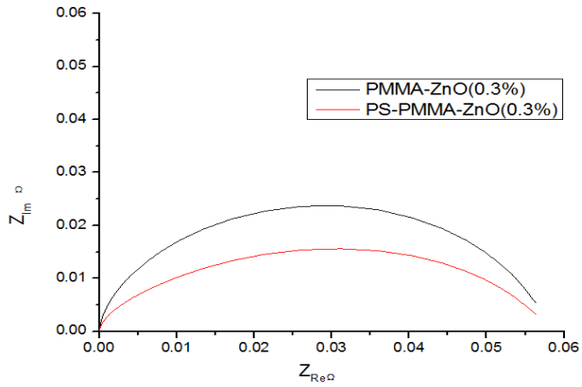
UV-Vis absorption spectrum of ZnO film

The presence of ZnO is confirmed since it is known that UV-Vis has an absorption band at approximately 370 nm (382 nm).

Characterization of polymer films



Spectrum of electrical impedance of polystyrene, polystyrene with incorporation of ZnO at 0.3% and polystyrene with incorporation of ZnO at 1% in KCl



Spectrum of electrical impedance of polymethylmethacrylate with incorporation of ZnO at 0.3% and copolymer polystyrene-polymethylmethacrylate with incorporation of ZnO at 0.3% in KCl.

Impedance spectroscopy is a technique that indi rectly allowsus to measure the conductive chara cter and the materials.The resistance to the trans fer of load is related to thediameter of the semic ircles that are obtained from thegraph.

We can see that the sample has no ZnO i s the onethat has the largest diameter, therefore the greatestresistance and with the highest conc entration of ZnO that is1% resistance decreases, indicating that it increases itsconductivity as th ey are reverse measurements.

Conclusions

The results obtained are conclusive to affirm that the polymerization processes were performed correctly in both emulsion and suspension, the characterization of the PS and PMMA polymers as well as the copolymer gave the expected result, as well as the characterization of the ZnO nano particles confirms that the sol-gel method was performed correctly.

The experimental methods used gave favorable results, however due to lack of time, more characterization tests are still pending such as SEM microscopy, NMR spectroscopy and FT-IR by diffuse reflectance in order to analyze the dispersion level of the ZnO particles in the polymer networks synthesized.

As the ZnO is a material that adsorbs the UV light, we canalso say that the higher conce ntration in the polymer matrixwill favor the prot ection to the solar radiation and theyellowing

References

I. - Timothy E. Long, James E. McGrath. 2008. “Polymers, Synthesis”. Encyclopedia of Physical Science and Technology, 3, 751–774.

II. - Chern, Chorng-Shyan. 2008. “Principles and Applications of Emulsion Polymerization”. Wiley VCH.

III.- Perelshtein, I.; Applerot, G.; Perkas, N.; Wehrschetz-Sigl, E.; Hasmann, A.; Guebitz, G. M. & Gedanken, A. 2008 “Antibacterial Properties of an In Situ Generated and Simultaneously Deposited Nanocrystalline ZnO on Fabrics”. ACS Applied materials and interfaces. 01 December 2008.

ISSN 2410-3438

IV. - Shaban, Mohamed; Abdallah, Semsem & Abdel-Khalek Ahmed. 2016. *"Characterization and photocatalytic properties of cotton fibers modified with ZnO nanoparticles using sol–gel spin coating technique".* Beni – suef university journal of basic and applied sciences 5 (2016) 277 – 283.

V. – Martin, Morget; Prasad, Neena; Mariappan-Sivalingam, Muthu; Sastikumar, D. & Karthikeyan, Balasubramanian. 2017. *"Optical, phonon properties of ZnO–PVA, ZnO–GO–PVA nanocomposite free standing polymer films for UV sensing".* J Mater Sci: Mater Electron.

ISSN 2410-3438

Article **Journal of Quantitative and Statistical Analysis**
June, 2019 Vol.6 No.18 11-15

Obtaining conductive composites of PANI and thermoplastic polymers

Obtención de compositos conductores de PANI y polímeros termoplásticos

CONTRERAS-ZARAZÚA, Diana Nelly†, CONTRERAS-LOPÉZ, David*, FUENTES-RAMIREZ, Rosalba and GALINDO-GONZÁLEZ Rosario

Universidad de Guanajuato

ID 1st Author: *Diana Nelly, Contreras-Zarazúa* / **ORC ID**: 0000-0001-8398-0865, **CVU CONACYT ID**: 885541

ID 1st Coauthor: *David, Contreras-Lopéz* / **ORC ID**: 0000-0003-1384-4766, **CVU CONACYT ID**: 38297

ID 2nd Coauthor: *Rosalba, Fuentes-Ramirez* / **ORC ID**: 0000-0003-0520-3387, **CVU CONACYT ID**: 202669

ID 3rd Coauthor: *Rosario, Galindo-González* / **ORC ID**: 0000-0002-3612-1555, **CVU CONACYT ID**: 223987

Received January 26, 2019; Accepted April 03, 2019

Abstract

Currently, the polymers industry has gained increasing importance due to the versatility of its properties. In this work were synthesized copolymers of styrene with vinyl acetate at different concentrations through a process polymerization of suspension, which are the starting points for obtaining of composites with polyaniline synthesized PANI chemical oxidative polymerization process, used for doping HCl at a concentration of 1.5 M and ammonium persulfate 0.5 M in a mass radio of 1:1. The conductivity was evaluated by means of cyclic voltammetry and impedance spectroscopy, in order to determine the effect of the concentration of the polar monomer in the composite founded that increase concentration of polar comonomer the conductivity also too.

Conductive polymers, Copolymers, Polyaniline

Resumen

En la actualidad, la industria de los polímeros ha cobrado una creciente importancia debido a la versatilidad de sus propiedades. En el presente trabajo de investigación, se sintetizaron copolímeros de estireno con acetato de vinilo a diferentes concentraciones en peso con respecto al estireno, mediante un proceso de polimerización por suspensión, los cuales son los puntos de partida para obtención de compositos conductores de polianilina (PANI). El PANI se sintetizo mediante un proceso de de química oxidativa, empleado para ello, un dopaje de HCl a una concentración de 1.5 M y persulfato de amonio 0.5 M en una relación másica de 1:1. Se evaluó la conductividad por medio de voltamperometría cíclica y espectroscopia de impedancia, con el objeto de determinar el efecto de la concentración del comonómero polar en el composito, encontrándose una que conforme aumenta la concentración del comonómero polar, la conductividad se incrementa.

Polímeros conductores, Copolímeros, Polianilina

Citación: CONTRERAS-ZARAZÚA, Diana Nelly, CONTRERAS-LOPÉZ, David, FUENTES-RAMIREZ, Rosalba and GALINDO-GONZÁLEZ Rosario. Obtaining conductive composites of PANI and thermoplastic polymers. Journal of Quantitative and Statistical Analysis. 2019 6-18: 11-15

* Correspondence to Author (email: david.contreras@ugto.mx)
† Investigador contribuyendo como primer autor.

Introduction

During recent years, the chemical industry focused on the development of polymeric materials has been increasing, demanding new materials with specific characteristics, due to this, conductive polymers are a growing area. These materials present a low cost of production, and a great variety of applications, for example, if they are used in solar or fuel cells, even being substitutes for some metals, which to obtain a large number of polluting processes and higher costs. This has given guidelines to review the effect that the products consumed have on the care of the environment.

The synthesis of vinyl-type copolymers is proceeded by a conventional polymerization mechanism free radical addition (FRP) by the suspension process. This method of production, industrially is the most common industrial level, mainly for the production of plastics, rubber and fibers; in comparison with other polymerization processes, since it has the advantage of being applied to a large variety of vinyl type monomers, it is easy to implement experimentally and is a relatively easy process to control, giving polymers with predetermined molecular weights by ratio of monomer concentrations consumed. [1]

Conductive polymers

This type of polymers also called synthetic metals or organic metals, were discovered in the decade of the 70's and since then until today a great interest has been awakened in the industrial and academic area. It should be noted that most organic polymers are excellent electrical insulators; while conducting polymers are capable of conducting electric current, being synthetic and almost all organic. These have delocalized links (often with an aromatic group) that form a structure similar to that of silicon. The most common conductive polymers are polypyrrole, polythiophene and polyaniline.

Polyaniline

Polyaniline (PANI) is a product of the oxidation of its monomer (aniline) in acidic conditions and is presented in 4 stable forms, depending on its level of oxidation: base pernigranilina (totally oxidized), emerald (partially oxidized) and leucoesmeraldina (totally reduced). Of these, the emerald base is the most stable and conductive. [2]

The PANI can be mixed with different types of polymers, providing conductivity to the resulting material, and accepting the properties of mechanical strength and / or processability left by the emitting polymer matrix. The production of a new class of materials by mixing polyaniline, ensures that a conductive material is dispersed in an insulating matrix,thin films are obtained by chemical or electrochemical synthesis in situ. The main dopants for the synthesis of aniline are hydrochloric acid (HCl), sulfuric acid (H_2SO_4), camphorsulfonic acid, acid phosphate ester and acetic acid. [3]

Materials and methods

Synthesis of copolymers

The synthesis of the copolymers was carried out with the monomers styrene (S) and vinyl acetate (VAc) at different percentages by weight with respect to styrene, and was obtained by means of a suspension polymerization process via conventional free radicals (FRP). Previously, the monomers are washed to remove the inhibitor, using 0.1 M sodium hydroxide (three times) and two with distilled water. Styrene and vinyl acetate used, have purity percentage> 99% (Sigma-Aldrich).

Continuing with the suspension polymerization process, this is carried out in a 250 mL reactor, using as a continuous medium an aqueous solution of PVA 89000 Da, 88% hydrolyzed (5 g/L). While, for the dispersed phase, the S-VAc mixture is added at 1%, 5%, 10%, 15%, 20% and 25% by weight, as the case may be, based on 20 mL of styrene. Benzoyl peroxide (BPO) reagent grade (Sigma-Aldrich) was used as the initiator.benzoilo), calculating the necessary weight for each mixture.

The synthesis was carried out at 85 ± 2 ° C at 400 rpm, in approximately 3 hours. When the copolymer is obtained, it is cooled in an ice bath and purified, filtering by gravity and washing with distilled water and 99.8% pure methanol, finally the yield and molecular weights are calculated. For the determination of molecular weights by viscosity (Mv) a Cannon-Fenske # 25 viscometer and the Mark-Houwink equation were used, using the values of the constants presented in Table 1.

ISSN 2410-3438

Copolymer	α	K
S -VAc 1%	0.6191	0.03771
S – VAc 5%	0.6155	0.04055
S – VAc 10	0.611	0.0441
S – VAc 15 %	0.6065	0.04765
S – VAc 20 %	0.602	0.0512
S – VAc 25%	0.5975	0.05475

Table 1 Mark-Houwink constants

Synthesis of Polyaniline

This reaction was carried out using the high purity aniline monomer (ANI, Sigma-Aldrich), 0.5 M ammonium persulphate solution and 1.5 M solution of hydrochloric acid (HCl) as doping agent, in a 250 mL reactor. Polymerization of oxidative chemistry started by adding 2.59 g of aniline to the reactor where previously 50 mL of 1.5 M HCl had been added, allowing the aniline to react for 25 min at 800 rpm, after this time, 50 mL of 0.5 M ammonium persulphate solution is added, leaving the reaction for 3 hours. Concluding this step, it is filtered by and washed with distilled water and methanol, subsequently, it is dried at 45 ° C for a period of approximately 24 hours until a constant weight of the conductive polymer is obtained.

Obtaining composites

To obtain the composites at different percentages, mixtures were elaborated in relation to the 1: 1 weight of the PANI as the conducting polymer at a degree of doping (1.5 M) and of the copolymer at different percentages by weight of vinyl acetate (1%, 5%, 10%, 15%, 20% and 25%). Mixing mechanically, adding on a watch glass 0.1 g of PANI and 0.1 g of the selected copolymer, adding 200 microliters of toluene to homogenize and a sonicator was used for 5 minutes to unify the mixture. Subsequently, the samples were placed in FTO glasses in an area of 1 cm2 and allowed to dry. Having the final composites, they were characterized by cyclic voltammetry and impedance spectroscopy to determine the conductivity of the polymer.

Results and discussion

Obtaining the S-VAc copolymers by the suspension polymerization method was relatively simple, having a precise control of the temperature and reaction time, there were no problems, in the same way, in the process of separation and purification of the compound.

Following the methodology outlined above, copolymers were obtained at different percentages of vinyl acetate with respect to styrene. In the product obtained, the change in particle size is notable and its homogeneity decreases as the percentage of VAc present increases, It also shows a large amount of coalescence and pearl breaks, this can be seen in Figure 1.

Figure 1 Pearls obtained from S - VAc at 15%, 20% and 25% w/S

Molecular weight tests of the composites were performed using the capillary viscometry technique, preparing 10 mL solutions, with concentrations of 0.01 g/mL, 0.005 g/L and 0.001 g/L using toluene> 99% as solvent medium. From each solution, 7 mL was used to analyze and each test was done in triplicate.

In Table 2 the molecular weights (Mw) obtained by this technique can be observed for the copolymers of S-VAc at 1%, 5%, 10%, 15%, 20% and 25% by weight with respect to styrene. The yields of each of the copolymerization reactions are also observed, by the wet weight and dry weight of the resulting product.

Material	Performance (%)	Molecular weight Mw (g/mol)
S -VAc 1%	85.28	12,671.67
S – VAc 5%	90.86	151,111.97
S – VAc 10	89.03	157,455.56
S – VAc 15 %	92.5	27,264.5016
S – VAc 20 %	81.63	26,992.8684
S – VAc 25%	72.6	81,073.14

Table 2 Yields and molecular weights of S-VAc copolymers

In the case of performance, a small range of variation is noted, however, in the calculated molecular weights, an increase considered in percentages of 5% and 10% is clear, having values without a visible tendency.

ISSN 2410-3438

Cyclic voltaperometry and impedance spectroscopy

According to what was formulated in the methodology, electrochemical tests of cyclic voltammetry and impedance spectroscopy were performed on the PANI synthesized, demonstrating the conductive characteristics present in this polymer.

Previously, the characteristic color of this compound, emerald green, which shows the partially oxidized state of polyaniline, had been revised.

The voltaperometric analysis was carried out in a potentiostat model SSP-150 Biologic Science Instruments with Software Ec-Lab V10.19, and a three-electrode cell at room temperature, using a working carbon electrode of 0.001 cm2, with previous polishing with alumina powder 0.03, 0. and 0.5 µm, then sonicate for 3 min and wash with deionized water, was used an electrode type Ag / AgNO3, and a platinum wire electrode with spring arrangement.

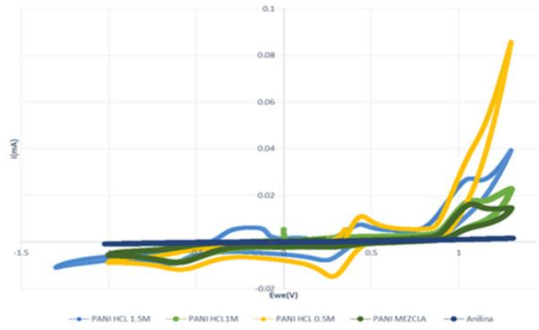


Figure 2 PANI voltammetry as well as the aniline monomer.

In Figure 2, the PANI voltaperogram is shown at different concentrations of doping agent, noting that the concentration of 1.5 M HCl increases the conductive character, with respect to the behavior of these voltammograms, it can also be identified that the aniline spectrum has no conductive property.

In the quantitative analysis of the conductivity of the PANI at different concentrations of doping agent were performed with the impedance spectroscopy technique, the spectrum is shown in Figure 3.

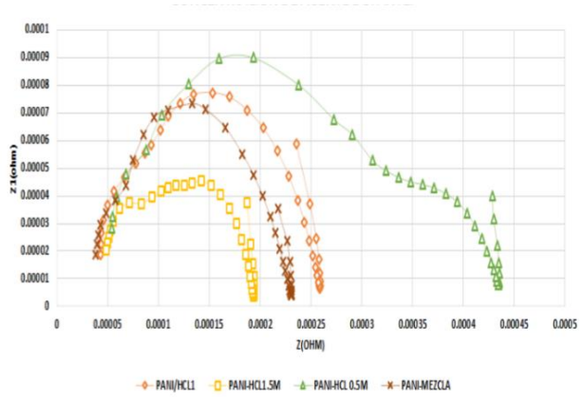


Figure 3 PANI impedance spectroscopy at different concentrations of HCl

As can be seen in the previous spectrum, the higher concentration of doping agent decreases the resistance of the material. With these resistances, the resistivities of the material and their respective conductivities can be obtained (see Table 3).

Material	Resistance (Ω)	Resistivity (Ω^{-1})	Conductivity (S/cm)
PANI/HCl 0.5 M	3.4×10^{-4}	1.21×10^{-2}	82.43
PANI/HCl 1.0 M	2×10^{-4}	7.14×10^{-3}	140.14
PANI/HCl 1.5M	1.35×10^{-4}	4.781×10^{-2}	209.16

Table 3. PANI conductivity table

In the previous table, it is noted that increasing the concentration of the doping agent improves the conductive properties of the polymeric material, considering it a semiconductor, with a maximum conductivity of 209.16 S / cm.

For the analysis of impedance spectroscopy of the composites, it was carried out in the FTO glasses, which are applied to measure their conductive capacity.

These materials were worked in 10 ml of potassium chloride support electrolyte 0.1 M, and with an impregnation area in the working electrode of 1 cm2.

With the spectra, the resistivities and conductivities of the 6 composites presented above were calculated.

ISSN 2410-3438

Material	Resistance (Ω)	Resistivity (Ω^{-1})	Conductivity (S/cm)
S -VAc 1%	9.98×10^{-3}	4.96×10^{-3}	201.6
S – VAc 5%	3.89×10^{-3}	1.94×10^{-3}	515.5
S – VAc 10	3.24×10^{-3}	1.66×10^{-3}	601.7
S – VAc 15 %	2.25×10^{-3}	1.38×10^{-3}	724.58
S – VAc 20 %	1.06×10^{-3}	1.27×10^{-3}	786.34
S – VAc 25%	8.15×10^{-4}	1.13×10^{-3}	886.32

Table 4 Table of conductivities of the composites with aniline at 1.5 M.

In Table 4, the conductivities tendency for composites is shown, where it can be observed that by increasing the concentration of the polar comonomer, the conductivity of the material increases. We can attribute these results to the chemical conformation of the S-VAc copolymer, where the vinyl acetate molecule presents its carbonyl group below the main chain, causing the carbonyl to provide a good mobility of electrons, consequently, a greater conduction, in comparison to a composition of S – methyl methacrylate (MMA) (Presented in the article "Synthesis of phenyl-type conducting polymers") [5], as the concentration of MMA increases, its conductive capacity decreases, the application of VAc in conductive materials is more feasible.

Conclusions

The S-VAc copolymers were synthesized successfully at different percentages by weight, obtaining good yields for this experimental part. It is worth mentioning that it was used as a conductive polymer PANI at a concentration of doping agent of 1.5 M, demonstrating a good conductive property.

In prepared composites, it is noted that by increasing the percentage polar monomer (VAc), increases the conductivity proportionally in these matrices.

References

[1] Coessens, V., Pintauer, T., y Matyjaszewski, K. (2001). Functional polymers by atom transfer radical polymerization

[2] Balint, R., Cassidy, N. and Cartmell, S. (2014). Conductive polymers: Towards a smart biomaterial for tissue engineering. Acta Biomaterialia,10(6), pp.2341-2353. Doi: 10.1016/j.actbio.2014.02.015

[3] Rodriguez P. J. Josue. (2016). Polimerización en suspensión de copolímeros de estireno por radicales libres para la formación de compositos de Polianilina. Jovenes en la Ciencia 2017, 3, 245

[4] Gacén, Cayuela D. y Galizia M. (2000). Peso molecular de las fibras acrílicas.

[5] F. Fernando, Galindo M. Contreras D. (2017). Síntesis de polímeros conductors tipo fenílicos. Verano de Investigacion UG 2017

ISSN 2410-3438

Article **Journal of Quantitative and Statistical Analysis**
June, 2019 Vol.6 No.18 16-24

Impact of the Quality Costs applied in Automotive and Metal-Mechanical Manufacturing SMEs in the North of Aguascalientes. Municipality of Rincon de Romos

Impacto de los costos de calidad aplicados en las PYME de fabricación automotriz y metalmecánica en el norte de Aguascalientes. Municipio de Rincón de Romos

VAZQUEZ-GUTIERREZ, Rosa Inés †*, FLORES-AGUILAR, Mauricio y NÚÑEZ-MONTALVO, Juan Manuel

Universidad Tecnologica del Norte de Aguascalientes

ID 1st Author: *Rosa Inés, Vazquez-Gutierrez* / **ORC ID**: 0000-0001-8774-7737, **Researcher ID Thomson**: X-2867-2018, **CVU CONACYT ID**: 529498

ID 1er Coautor: *Mauricio, Flores-Aguilar* / **ORC ID**: 0000-0003-0846-3803, **Researcher ID Thomson**: X-2169-2018, **CVU CONACYT ID**: 687471

ID 2do Coautor: *Juan Manuel, Núñez-Montalvo* / **ORC ID**: 0000-0003-1053-8843, **Researcher ID Thomson**: X-3186-2018, **CVU CONACYT ID**: 260539

Received January 23, 2019; Accepted March 02, 2019

Abstract

This research is the result of 4 investigations carried out in the northern region of Aguascalientes. The municipalities on which this research is based are Aguascalientes, San Francisco de los Romo, Rincon de Romos, and Jesús María. The objective of this study is to investigate the costs incurred by companies in carrying out their operations in the municipality of Rincon de Romos. The realization of this research allows us to know the costs incurred by these surveyed companies in order to know in what percentage the highest quality costs applied, whether in prevention costs, evaluation costs, internal failure costs and external failure costs.

Quality costs, Internal failure costs, External failure costs, Prevention costs, Evaluation costs

Resumen

Esta investigación es el resultado de 4 investigaciones realizadas en la región del norte de Aguascalientes. Los municipios en los cuales se basa esta investigación son Aguascalientes, San Francisco de los Romo, Rincon de Romos, y Jesús María. El presente trabajo tiene como objeto investigar cuales son los costos en los cuales las empresas incurren al realizar sus operaciones en el municipio de Rincon de Romos. La realización de esta investigación permite conocer cuáles son los costos en los que incurren estas empresas encuestadas y clasificarlos en costos de prevención, costos de evaluación, costos de fallas internas o fallas externas.

Costos de calidad, Costos de fallas internas, Costos de fallas externas, Costos de prevención, Costos de evaluación

Citación: VAZQUEZ-GUTIERREZ, Rosa Inés, FLORES-AGUILAR, Mauricio y NÚÑEZ-MONTALVO, Juan Manuel. Impact of the Quality Costs applied in Automotive and Metal-Mechanical Manufacturing SMEs in the North of Aguascalientes. Municipality of Rincon de Romos. Journal of Quantitative and Statistical Analysis. 2019 6-18: 16-24.

* Correspondence to Author (email: rosa.vazquez@utna.edu.mx)
† Investigador contribuyendo como primer autor.

Introduction

This report presents an analysis of the situation of quality costs incurred by SMEs in the municipality of Rincon de Romos.

The companies that were explored in this municipality were balconies and metal mechanic workshops that are dedicated to the transformation of metals in the simplest forms, such as the creation of windows, the machining of metal parts, machinery or more processed parts.

The investigation is divided into six areas:

a) Leadership
b) Strategic approach.
c) Focus on markets and customers.
d) Management of people.
e) Quality Costs
f) Process management

The Costs of Quality are classified as:

a) Prevention costs
b) Evaluation costs
c) Internal failure costs
d) External failure costs

Then the results of the survey applied to a sample of 13 companies from a universe of 36 companies that correspond to 30% metal-mechanical branch in this municipality according to the DENUE 2015 of INEGI are shown.

This project benefits the automotive industry and mechanical metal because it allows us to know what are the strengths and weaknesses in the application of quality costs, as well as it allowed us to know our University, UTNA, which are the courses that it can offer on these topics of quality in order to strengthen SMEs in the region.

This research is of relevant importance since the quality applied in the companies is required to be able to satisfy the needs of the clients and to be able to maintain in the market.

Methodology

According to Hernández Sampieri (2010) the study that was applied was a "Quantitative Exploratory" study where a data recovery tool, survey type, will be used.

Sampling

The type of sampling that will be carried out will be stratified, where the total population of each of the municipalities in different strata is divided. The advantage of this type of sampling is that it tends to ensure that the sample adequately represents the population based on selected variables. It also allows obtaining more precise estimates and its objective is to obtain a sample that is as similar as possible to the population in terms of the stratifying variable (s).

The result was a sample of 13 companies from a universe of 36 companies registered in the DENUE 2016 of the INEGI

Background

Quality costs represent the difference between the actual costs of a product or service and the reduced cost if it had not had the possibility of having a service below the standards, product failures, or defects in its manufacture.

They can be classified as observable or hidden, the observables are those found in the accounting records of an organization, the hidden costs are the opportunities that those of poor quality. All quality costs are observable and should be available in the accounting records, the hidden costs in the external failure category.

These costs can be important and should be estimated, although not easy, for which three methods are used.

1. The multiplier method.
2. The market research method.
3. The quality loss function of Taguchi.

The market research method is the one that will be carried out, this is used to evaluate the effect of poor quality. The surveys applied are based on questions elaborated from the classification of the four types of quality costs that are explained below.

ISSN 2410-3438

Prevention cost:

They are the costs of all activities specifically designed to prevent quality failures in products or services. *For example:*

– Review of new products.
– Quality planning (manuals, procedures, etc.)
– Evaluation of supplier capacity.
– Efforts for improvement through teamwork.
– Continuous improvement projects.
– Education and quality training.

Evaluation cost:

They are the costs associated with the activities of measuring, evaluating and auditing the products or services to ensure their conformation to quality standards and performance requirements. *For example:*

– Inspections with the supplier and on receipt.
– Tests and inspections in process and to the finished product.
– Audits to the product, process or service.
– Calibration of test and measurement equipment.
– Costs of test materials.

Internal failure cost:

They are the costs resulting from products or services that do not conform to the requirements or needs of the client, before the product is shipped or when the service is performed. *For example:*

– Waste
– Re-jobs
– Re-inspection and repetition of tests
– Review of non-conforming materials
– Reduced price for reduced *quality*

Internal failure cost:

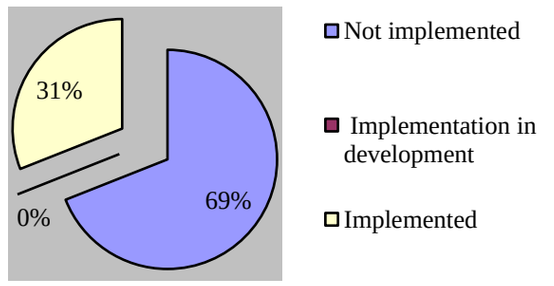
They are the costs resulting from products or services that do not conform to the requirements or needs of the client, after the delivery of the product or during and after the completion of the service. *For example:*

– Complaints and complaints process
– Customer returns
– Guarantee
– Campaigns for defective *products*

Results

Leadership

In Rincon de Romos, the companies surveyed stated that they had vision, mission, values and objectives in 31% while 69% of them did not count on it.



Graphic 1 Implementation of the mission, values and strategic objectives

These companies, 77% of their members of the company know the responsibilities and actions they must perform while 23% said they do not have a procedure for this.

Another aspect that was evaluated is if the companies focus on the creation and innovation of new products, the companies responded by 77% that they have implemented this aspect, while 8% seek to develop it and 15% do not count on it.

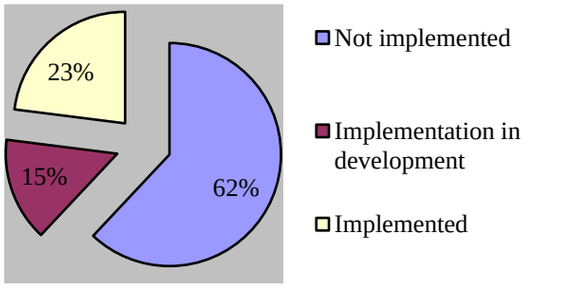
Also of these companies, only 8% have a policy for environmental aid, another 8% seek to develop it and 84% do not count on it.

None of the companies is certified with ISO 14000, only 8% seek this certification and the rest, as mentioned, is not certified.

Strategic approach

In the area of strategic approach, these companies have a process to consider the expectations of markets and customers by 23%; while 15% are seeking to implement it and 62% have not implemented it.

ISSN 2410-3438



Graphic 2 In Rincon de Romos 23% of the companies do not have a planning process where they limit their competitive scenario and consider the expectations of the markets and customers.

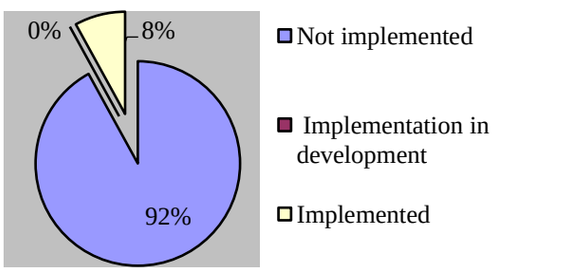
These companies have a 31% planning process where shareholders' aspirations are considered, while 69% said they did not count on it. In addition, in Rincon de Romos, companies have a planning process that considers the capacities of the company and its workers by 31%, while 15% are seeking to implement it and 54% have not implemented it.

These companies also have a planning process where the capacities of their suppliers are considered in 38%, although 62% do not.

Focus on markets and clients

In the area of market and customer focus, 38% have procedures where the company determines the markets where their most important customers will be, 15% seek to implement this procedure and 46% do not have it implemented. 15% of the companies consulted have a method to investigate what are the requirements of customers according to the products and / or services offered, while 8% of companies seek to implement this method and 77% do not implemented.

In Rincon de Romos, 8% of the companies consulted seek to implement a method of market research to detect new businesses, 92% do not.

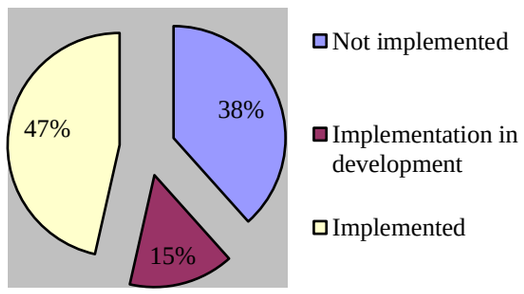


Graphic 3 Method of market research to detect new businesses

38% of the companies analyzed have a formal procedure to ensure that complaints and claims are resolved in a timely manner, 8% seek to implement it and 54% do not.

Management of people

In the section on people management, 46% of companies plan to select their workers, 15% seek to implement this procedure, while 38% do not.



Graphic 4 En Rincon de Romos el 46% de las empresas consultadas tiene en proceso de implementación la selección de sus trabajadores

In Rincon de Romos, 46% of companies plan the training and development of their workers, while 23% seek to implement it and 31% have not implemented it.

In addition, 31% of these companies communicate clear goals and work assignments that guide the staff in their action, 23% of these companies seek to implement it and 46% have not implemented it.

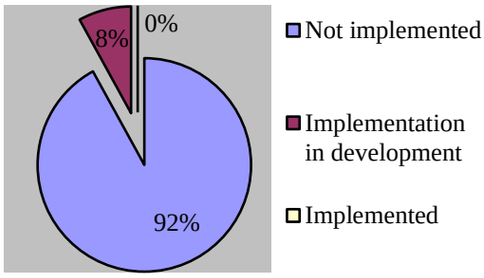
77% of companies do not have a remuneration policy and structure that covers all jobs that ensure the quality and competitiveness of the company, while 23% do so.

Only 8% of the companies consulted have methods of recognition and reward for the achievement of objectives that ensure the quality and competitiveness of the company, 15% wish to implement it, while 77% have not implemented it.

8% of companies seek to implement a safety and hygiene department and 92% do not count on it.

92% of companies do not have OHSAS 18001 certification, only 8% seek to implement it.

ISSN 2410-3438



Graphic 5 Implementation of the OHSAS system

Quality costs

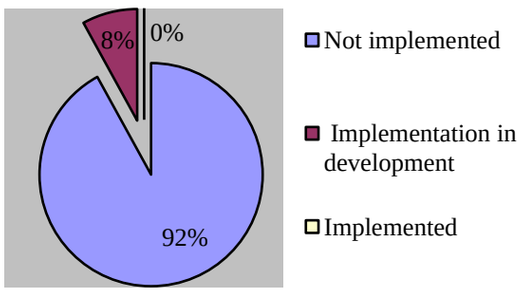
This item was divided into 4 stages for its investigation, then the results of each of these stages are explained.

I. Prevention costs

The companies of Rincon de Romos, in 77% of these inspect the material when it arrives at the plant, 8% seek to implement this process and 15% do not have it implemented. Of these companies, 15% have plant distribution, while 8% seek to implement it and the rest, 77% have not implemented it.

On the other hand, of these companies only 31% have 5'S application, while 23% seek to implement it and 46% do not count on it.

Regarding Quality Management Systems, only 8% have a QMS applied, while 92% do not have it. This is reflected because again 8% of the companies consulted use verification sheets and 92% do not.



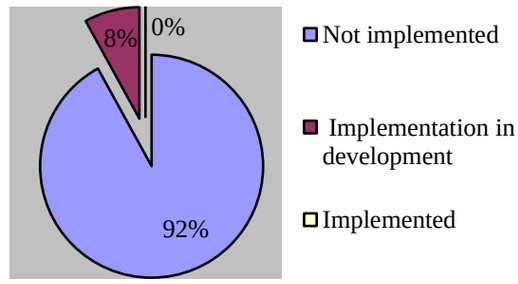
Graphic 6 *Implementation of Quality Management Systems*

The same happens with the formats implemented, 8% have them and 92% do not have them. While 38% have procedures in place, 15% seek to implement them and 46% do not have them. Likewise, only 8% have a quality manual implemented, while 92% do not count on it.

8% of these companies have a recruitment area, while 92% do not count on it.

It was also mentioned that 8% of the companies consulted are developing how to have trained personnel to recruit, while the remaining 92% are not considering it.

In the area of internal quality audits, 8% are seeking to implement this tool, while 92% do not have this.



Graphic 7 Use of Internal Quality Audits

The same happens with external quality audits where 8% said they have this tool in development and the remaining 92% do not use this tool.

Another questionable tool was whether there is a product design area, where 8% say they count on it, while 92% do not use it.

These companies, said that 31% have a metrology area, while 8% seek to develop this area and 62% do not have it.

Also questioned about the application of quality circles within each company, 8% mentioned that if you use this tool, while 92% does not apply it.

These companies stated that they have continuous improvement projects in 23%, however 77% do not count on it.

8% implements the Kaizen day, while 92% does not apply it. 100% of the companies consulted said they did not have a marketing department. Likewise, 100% of these companies do not conduct marketing research.

In addition, 8% mentioned that they have planned that their vendors with whom they have some type of certification, while 92% have not considered it.

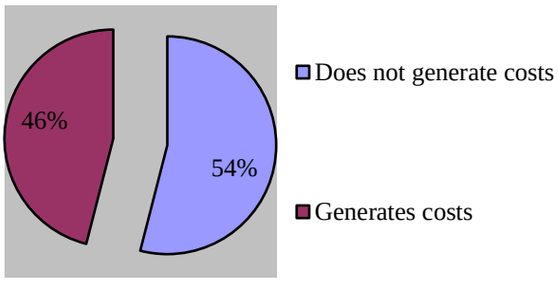
ISSN 2410-3438

II. Evaluation costs

In Rincon de Romos, the companies consulted said that 54% of them carry out inspections with the supplier, 8% seek to implement this procedure and 38% do not count on it.

These companies mentioned that 69% of them have a raw material inspection before going into production, 8% seek to implement this procedure and 23% do not count on it.

On the other hand, they mentioned that 46% of these companies have costs in returning damaged raw materials, while 54% said they do not generate these costs.



Graphic 8 Percentage of companies that generate costs return damaged raw material

23% said that these companies have some kind of inspection in their packaging, while 77% do not.

In Rincon de Romos, 8% have a check list or verification sheets to know the conditions of their products, while 92% do not have it.

In these companies, 77% of them carry out the evaluation of the product before going on the market, while 8% seek to implement this process, 15% of them do not have the procedure.

Of these companies, 31% said they have communication between the client and the supplier to establish the conditions of the product before it reaches the company, while 8% seek to implement it and 62% do not count on it.

In this aspect, it was evaluated if the companies carried out some type of inspection in the prototypes they made, 15% said yes, while 85% said no.

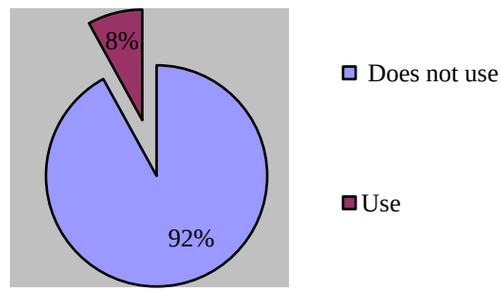
8% perform product audits, however 92% do not carry it out.

While 15% carries out audits of the process and the remaining 85% does not carry it out.

In addition, 8% carry out customer service audits, while 92% do not.

Another aspect evaluated was if there are calibration systems for measuring equipment, 15% said yes, while 85% said no.

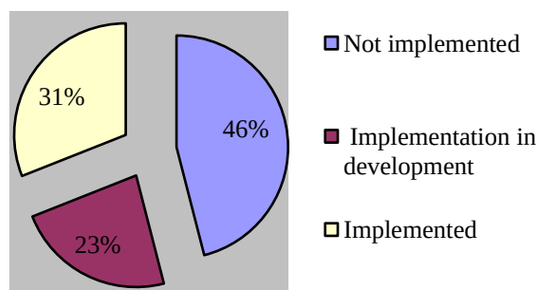
In addition, 8% of these companies have a test equipment calibration system, while 92% do not have it.



Graphic 9 Use of test calibration equipment

III. Costos de falla interna

In Rincon de Romos these companies said that in 31% of these companies have some type of waste that generates cost and 69% say otherwise. On the other hand, 46% said they had re-work, 23% said they were looking for a process to do re-jobs and 31% said they did not have rework.

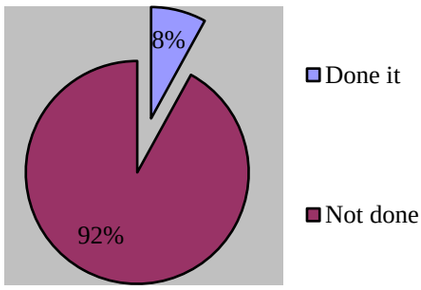


Graphic 10 Companies with re-work.

Of the companies consulted, 54% said they had re-inspections and 45% said they did not have re-inspections.

In addition, 8% of the companies consulted perform repairs internally and 92% do not have these procedures.

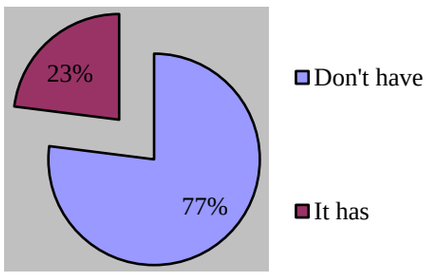
ISSN 2410-3438



Graphic 11 Companies that carry out repairs internally

IV. External failures costs

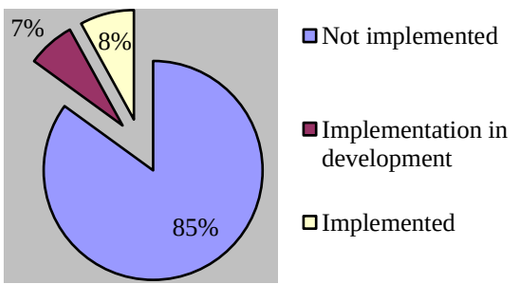
In the companies consulted 23% of these have a system within the company that regulates the returns and / or tolerances of the product, while 77% do not count on it.



Graphic 12 Companies that have a system regulates the returns and / or tolerances of the product

Of these companies, 54% offer discounts to customers, while 23% do not carry it out and the other 23% seek to implement it.

85% of the companies said they were responsible for the product at the time of delivery, while 15% is not. Regarding the area of having a complaints department, these companies have an 8% with it, while 85% of them do not count on it and 7% seek to implement it.



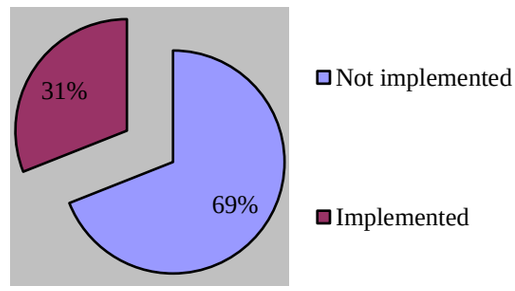
Graphic 13 Complaints Department

Of these companies, 54% of companies have a defective product recovery process, while 46% do not count on it.

The companies consulted said that 46% generated some type of cost to recover the defective product, and 54% said no.

In Rincon de Romos the companies interviewed perform the corresponding tasks against the ill will that there is in the company in 62%, while the remaining 38% do not count on it.

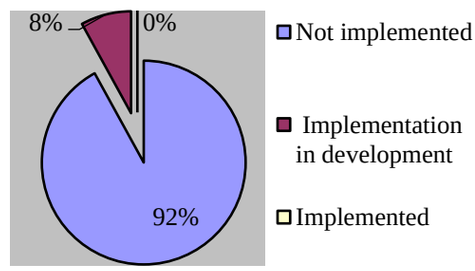
31% have training to improve the work environment, while 69% do not have it.



Graphic 14 Trainings to improve the Labor Climate

Process management

In the area of process management, the Rincon de Romo companies define documents by 8% and establish responsibilities for the processes that make up the value chain, while 92% do not. 92% of the companies consulted maintain a system of indicators and process metrics with their corresponding competitive references, while 8% do not have it.



Graphic 15 System of indicators and process metrics

62% of the companies analyzed in Rincon de Romos, these companies consider the requirements of customers and the market in the design of their processes, while 38% of them do not.

31% of companies establish standards and indicators of the quality of their processes, while 69% do not.

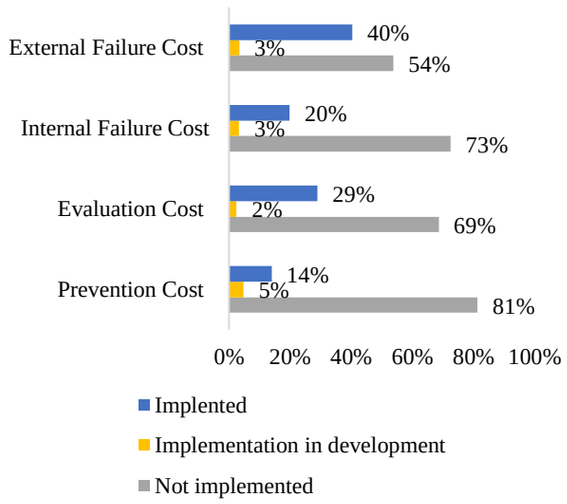
ISSN 2410-3438

Companies develop their established suppliers by monitoring quality indicators for specific processes by 8%, while 92% do not.

Conclusions

The companies consulted in Rincon de Romos need to cement the structure of the leadership field because a high percentage do not have the mission, vision and policies well, and they must also define the necessary policies to move from an autocratic leadership to a participatory one.

In strategic planning they do not have the adequate planning to create a more competitive scenario and this can lead them to close because they are not considering the long-term expectations of the clients.



Graphic 16 Quality Cost in Rincon de Romos

In this graph we can see that there is an implementation of the tools of external failure costs by 40%, as tools of internal failure costs by 20%, on tools of evaluation costs by 29% and 14% on costs of prevention, for this reason we can observe:

When companies show deficiencies in the implementation of leadership, they put their permanence and competitiveness at risk in the industrial sphere, because they can not maintain the commitment and loyalty of their associates.

The lack of planning of the companies, can limit their development as well as the diversification of their products and services according to the needs of their clients.

At the point of people management, companies must put more emphasis on the selection, as well as on the training of people, since the tendency in companies is to continuous improvement and without trained human capital, companies They will see more limited and less competitive.

At the point of evaluation costs, companies need to involve their suppliers more in order to prevent at source the failures of the services and products they provide to their final customers, which will reduce the quality costs for both companies as for suppliers and customers.

It is important to consider in the same way that the companies in question of process management have to start improving their control of documents and at the same time set responsibilities on the processes that make up the value chain since most of them do not and this to the long causes more serious problems in their processes.

It is also very important to mention that in this investigation it was detected that most of the companies do not have a quality standardization control or apply quality indicators that allow them to know how their processes are behaving, this part is very fundamental that by not knowing their indicators or quality standards there is a risk of high costs due to poor quality. Companies not knowing their quality standards or quality indicators are not in a position to monitor the indicators of the processes handled by their suppliers, which in this investigation was a very significant result and which argues even more than the cost per poor quality are higher by not having these procedures to ensure the total quality in the production processes handled by the companies studied

Recommendations

First of all, it is necessary that these companies establish the mission, vision and quality objectives so that the company has a clear vision of what its objective is. In the same way, it is necessary to establish a strategic planning that guarantees them to remain in the market. Likewise, it is necessary to make a good selection of your personnel, train them and find a way to feel the need to belong.

ISSN 2410-3438

The companies of this region are recommended to use at least the basic tools of quality as well as to implement the bases of a quality system to have their processes documented and this allows them to guarantee the quality of their products, continue with the knowledge of the elaboration of the same ones and to use the documents of quality so that they can train the personnel that work with them in a future with the purpose of avoiding the backward movement in the elaboration of their products.

Similarly, it is recommended that companies perform monthly or quarterly evaluations of their quality indicators of both their processes and that of their suppliers so that the correct execution of the quality tools that are implemented is guaranteed and thus continue with the continuous improvement that every organization must maintain to be able to survive in a globalized business world where the failure to carry out a good quality deployment can be the guideline to follow or not in the competitive market of each of the items to which belongs to each of the organizations studied in this research.

It is recommended that companies perform the application of basic quality tools, for which companies must work hard in their correct application and training from this study which has been very useful for all organizations surveyed.

References

Aburto Jiménez, Manuel. Administración por calidad México: CECSA, 1997 c1992

Ads Quality. Enciclopedia de la Calidad. España: 2002

Blanco Llano, Francisco Javier. Diseño de procesos claves para el mejoramiento de la calidad.La Habana : Instituto Superior Politécnico José Antonio Echeverría. CUJAE, 2010

Del Río, González. Costos 1. México: ECAFSA, 1998.

Del Río, González Costos 3 . México: ECAFSA, 1999.

Cantú Delgado, Humberto. Desarrollo de una cultura de calidad México, D.F.: McGraw-Hill/Interamericana, 2011

Crosby, Philip B. La calidad no cuesta: el arte de cerciorarse México: CECSA, 1987

Crosby, Philip B . Calidad sin lágrimas. México: Continental. (2000).

Deming, W. Edwards Calidad, productividad y competitividad: la salida de la crisis Madrid: Ediciones Díaz de Santos, c1989.

Don R. Hansen. Maryanne M. Mowen. Administración de costos, contabilidad y control. México D.F., Thomson, (2003).

Evans, Jame. Lindsay, William. Administración y control de la calidad. México: 2005. Thomson.

Gutiérrez Pulido, Humberto. Calidad Total y Productividad México, D.F.: McGraw-Hill Education, 2010.

Gutiérrez Pulido, Humberto. Control estadístico de la calidad y seis sigma México, D.F.: McGraw-Hill Education, 2013.

Harrington, H. J. Mejoramiento de los procesos de la empresa. Colombia: 1998. McGraw-Hill

Hernández Sampieri, Roberto. Metodología de la investigación México, D.F.: McGraw-Hill, 2010.

INEGI, Directorio Estadístico Nacional de Unidades Económicas (DENUE), año 2016.

Instituto Mexicano de Normalización y Certificación, Sistemas de gestión de la calidad-requisitos (ISO 9001:2008) México: IMNC, 2008

Ripoll, V., & Balada, T.. (2005). Información de costes para la toma de decisiones empresariales. España: Rotapapel.

Valdes. La sexta generación de los procesos de calidad. Buenos Aires (Argentina) : El Cid Editor, 2009

ISSN 2410-3438

[Title in Times New Roman and Bold No. 14 in English and Spanish]

Surname (IN UPPERCASE), Name 1st Author†*, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor

Institutional Affiliation of Author including Dependency (No.10 Times New Roman and Italic)

International Identification of Science - Technology and Innovation

ID 1st Author: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st author: (Scholar-PNPC or SNI-CONACYT) (No.10 Times New Roman)

ID 1st Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 2nd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 2nd coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 3rd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 3rd coauthor: (Scholar or SNI) (No.10 Times New Roman)

(Report Submission Date: Month, Day, and Year); Accepted (Insert date of Acceptance: Use Only ECORFAN)

Abstract (In English, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In English)

Indicate 3 keywords in Times New Roman and Bold No. 10

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In Spanish)

Indicate 3 keywords in Times New Roman and Bold No. 10

Citation: Surname (IN UPPERCASE), Name 1st Author, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor. Paper Title. Journal of Quantitative and Statistical Analysis. Year 1-1: 1-11 [Times New Roman No.10]

* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

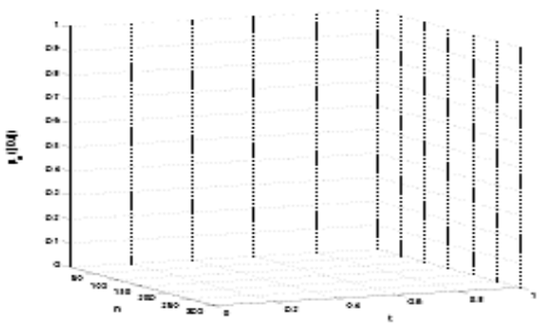
[Title No.12 in Times New Roman, single spaced and bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



Graphic 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

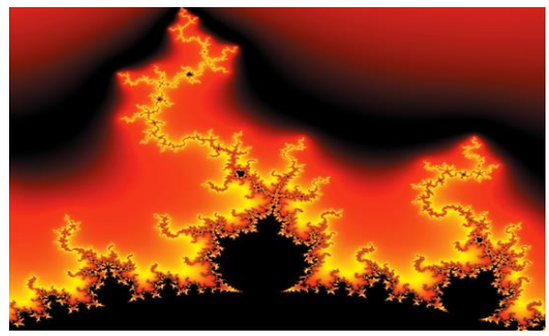


Figure 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Table 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Each article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \qquad (1)$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources

Thanks

Indicate if they were financed by any institution, University or company.

Conclusions

Explain clearly the results and possibilities of improvement.

ISSN 2410-3438

References

Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

Use Roman Alphabet, all references you have used must be in the Roman Alphabet, even if you have quoted an Article, book in any of the official languages of the United Nations (English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic), you must write the reference in Roman script and not in any of the official languages.

Technical Specifications

Each article must submit your dates into a Word document (.docx):

Journal Name
Article title
Abstract
Keywords
Article sections, for example:

1. Introduction
2. Description of the method
3. Analysis from the regression demand curve
4. Results
5. Thanks
6. Conclusions
7. References

Author Name (s)
Email Correspondence to Author
References

Intellectual Property Requirements for editing:

-Authentic Signature in Color of Originality Format Author and Coauthors

-Authentic Signature in Color of the Acceptance Format of Author and Coauthors

ISSN 2410-3438

Reservation to Editorial Policy

Journal of Quantitative and Statistical Analysis reserves the right to make editorial changes required to adapt the Articles to the Editorial Policy of the Journal. Once the Article is accepted in its final version, the Journal will send the author the proofs for review. ECORFAN® will only accept the correction of errata and errors or omissions arising from the editing process of the Journal, reserving in full the copyrights and content dissemination. No deletions, substitutions or additions that alter the formation of the Article will be accepted.

Code of Ethics - Good Practices and Declaration of Solution to Editorial Conflicts

Declaration of Originality and unpublished character of the Article, of Authors, on the obtaining of data and interpretation of results, Acknowledgments, Conflict of interests, Assignment of rights and Distribution

The ECORFAN-Mexico, S.C Management claims to Authors of Articles that its content must be original, unpublished and of Scientific, Technological and Innovation content to be submitted for evaluation.

The Authors signing the Article must be the same that have contributed to its conception, realization and development, as well as obtaining the data, interpreting the results, drafting and reviewing it. The Corresponding Author of the proposed Article will request the form that follows.

Article title:

– The sending of an Article to Journal of Quantitative and Statistical Analysis emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Format of Originality for its Article, unless it is rejected by the Arbitration Committee, it may be withdrawn.

– None of the data presented in this article has been plagiarized or invented. The original data are clearly distinguished from those already published. And it is known of the test in PLAGSCAN if a level of plagiarism is detected Positive will not proceed to arbitrate.

– References are cited on which the information contained in the Article is based, as well as theories and data from other previously published Articles.

– The authors sign the Format of Authorization for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Bolivia considers pertinent for disclosure and diffusion of its Article its Rights of Work.

– Consent has been obtained from those who have contributed unpublished data obtained through verbal or written communication, and such communication and Authorship are adequately identified.

– The Author and Co-Authors who sign this work have participated in its planning, design and execution, as well as in the interpretation of the results. They also critically reviewed the paper, approved its final version and agreed with its publication.

– No signature responsible for the work has been omitted and the criteria of Scientific Authorization are satisfied.

– The results of this Article have been interpreted objectively. Any results contrary to the point of view of those who sign are exposed and discussed in the Article.

Copyright and Access

The publication of this Article supposes the transfer of the copyright to ECORFAN-Mexico, SC in its Holding Bolivia for it Journal of Quantitative and Statistical Analysis, which reserves the right to distribute on the Web the published version of the Article and the making available of the Article in This format supposes for its Authors the fulfilment of what is established in the Law of Science and Technology of the United Mexican States, regarding the obligation to allow access to the results of Scientific Research.

Article Title:

Name and Surnames of the Contact Author and the Coauthors	Signature
1.	
2.	
3.	
4.	

Principles of Ethics and Declaration of Solution to Editorial Conflicts

Editor Responsibilities

The Publisher undertakes to guarantee the confidentiality of the evaluation process, it may not disclose to the Arbitrators the identity of the Authors, nor may it reveal the identity of the Arbitrators at any time.

The Editor assumes the responsibility to properly inform the Author of the stage of the editorial process in which the text is sent, as well as the resolutions of Double-Blind Review.

The Editor should evaluate manuscripts and their intellectual content without distinction of race, gender, sexual orientation, religious beliefs, ethnicity, nationality, or the political philosophy of the Authors.

The Editor and his editing team of ECORFAN® Holdings will not disclose any information about Articles submitted to anyone other than the corresponding Author.

The Editor should make fair and impartial decisions and ensure a fair Double-Blind Review.

Responsibilities of the Editorial Board

The description of the peer review processes is made known by the Editorial Board in order that the Authors know what the evaluation criteria are and will always be willing to justify any controversy in the evaluation process. In case of Plagiarism Detection to the Article the Committee notifies the Authors for Violation to the Right of Scientific, Technological and Innovation Authorization.

Responsibilities of the Arbitration Committee

The Arbitrators undertake to notify about any unethical conduct by the Authors and to indicate all the information that may be reason to reject the publication of the Articles. In addition, they must undertake to keep confidential information related to the Articles they evaluate.

Any manuscript received for your arbitration must be treated as confidential, should not be displayed or discussed with other experts, except with the permission of the Editor.

The Arbitrators must be conducted objectively, any personal criticism of the Author is inappropriate.

The Arbitrators must express their points of view with clarity and with valid arguments that contribute to the Scientific, Technological and Innovation of the Author.

The Arbitrators should not evaluate manuscripts in which they have conflicts of interest and have been notified to the Editor before submitting the Article for Double-Blind Review.

Responsibilities of the Authors

Authors must guarantee that their articles are the product of their original work and that the data has been obtained ethically.

Authors must ensure that they have not been previously published or that they are not considered in another serial publication.

Authors must strictly follow the rules for the publication of Defined Articles by the Editorial Board.

The authors have requested that the text in all its forms be an unethical editorial behavior and is unacceptable, consequently, any manuscript that incurs in plagiarism is eliminated and not considered for publication.

Authors should cite publications that have been influential in the nature of the Article submitted to arbitration.

Information services

Indexation - Bases and Repositories

LATINDEX (Scientific Journals of Latin America, Spain and Portugal)
RESEARCH GATE (Germany)
GOOGLE SCHOLAR (Citation indices-Google)
REDIB (Ibero-American Network of Innovation and Scientific Knowledge- CSIC)
MENDELEY (Bibliographic References Manager)

Publishing Services:

Citation and Index Identification H.
Management of Originality Format and Authorization.
Testing Article with PLAGSCAN.
Article Evaluation.
Certificate of Double-Blind Review.
Article Edition.
Web layout.
Indexing and Repository
ArticleTranslation.
Article Publication.
Certificate of Article.
Service Billing.

Editorial Policy and Management

21 Santa Lucía, CP-5220. Libertadores -Sucre–Bolivia. Phones: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; Email: contact@ecorfan.org www.ecorfan.org

Journal of Quantitative and Statistical Analysis

2410 3438
ISSN 2410 - 3438
www.ecorfan.org