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New Analysis Methodology to Evaluate the Environmental Factors and the Deterioration of Metallic Surfaces in the Electronics Industry

Francisco Ramírez Moreno[1], Sebastián Velarde Córdova[2], Héctor Alejandro Peláez Molina[3], Homero Jaime Rodríguez Centeno[4]

[1,2,3,4]*Tecnológico Nacional de México, Instituto Tecnológico de Mexicali, Mexicali, Baja California, México*

***Abstract*-- Based on the use of industrial and computing engineering tools, a new method was developed with a VEGAM matrix for the rapid and effective detection of the effects of the environment (climate and air pollution) on equipment and machines used in the electronics industry. This was done with a staff developed by experts from the National Technological Institute based in the Technological Institute of Mexicali, obtaining an efficiency of 95% in its application in the electronic industry of the city of Mexicali.**

***Keywords*-- Methodology, education, skills, quality, chemistry, environmental, industry, electronics.**

I. INTRODUCTION

The application of the new methodologies in the industrial and computing engineering is very useful in diverse areas of industries in the manufacturing processes. The main stages of analysis of the methodology applied in this investigation were: 1) the detection of some errors caused by automatic and manual operations, 2) the evaluation of the application of the novel methodology used in this study, 3) the determination of new procedures in the manufacturing areas to be used as a conceptual, methodological, human and top management) resources, 4) the use of experiments for the development of the novel methodology and 5) the analysis in some new processes of the novel methodology[1]. The aforementioned functions were used for the analysis prepared in an area of a company of the electronic industry of the Mexicali city, to develop the new method based on experimental tests. With this method, was very esy and fast, the detection of the principal effects of the air pollution factors in the funciton of the electronic as micro and macro components of industrial equipment and machinery. of the electronic industry in this city considered as arid zone of the northwest of the Mexican Republic. The climatic factors evaluated were essentially relative humidity, temperature and air pollutants (sulfides and nitrogen oxides) in the city of Mexicali. This procedure can also be applied to analyze chlorides and sulphides in marine regions.

Use of methodologies in the industrial and computing processes

The study of the methodologies used in the industrial engineering is one of the most important techniques of the work study, which is based on the registration and systematic critical examination of the existing and projected methodology used to carry out a work or operation[2]. The fundamental objective of these analyzes is to apply simpler and more efficient methods in order to increase the productivity of any productive system. The evolution of the methodologies used in industrial processes of the electronic industry, is to develop as a main source the evaluations at a general level of the problematic situations and later evaluate in greater detail each of these to detect the main causes and eliminate them and thus avoid consequences that lead to great economic losses. This is, every industrial process, must be evaluated according to its operation and problematic situation. In many cases there are doubts about the order of the application of each methodology, and even more being innovative, but with the expert staff that elaborated this study, the doubts are eliminated. for the analysis processes in the manufacturing areas of the electronic industry, evaluating from manual operations, to those elaborated by equipment and industrial machinery. That is why the methodologies of industrial processes, are related to the reduction of the work content of a task or operation, and in turn with the measurements, where the statistical information is required in each analysis is obtained. In addition, there is a close link with the investigation of unproductive times associated with a particular method. Therefore, it could be deduced that one of the functions of the use of new methodologies is to be part of the evaluation stage with the use of mathematical algorithms, using computer systems to elaborate the comparison of the current methodology and the new methodology, where they set the production standards, which in practice will be very useful when carrying out each industrial operation, as is the sampling of the work[3].

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Damage to metallic materials

The deterioration of industrial materials is due to exposure to aggressive environments. This occurs mainly due to two factors, the first being due to drastic variations in humidity and temperature and the exposure of pollution agents, such as sulfuric acid (H2S), sulfides (SOX), nitrogen oxides (NOX) in arid climates. and the same pollutants combined with chlorides (Cl-) in arid and marine areas, in industrial plant interiors. The generation of a process of deterioration by aggressive environments, originates anodic and cathodic zones that initiate the process of corrosion[4]. The most common type of corrosion is atmospheric corrosion, damaging all types of material. Based on the analysis of climatic and environmental factors, other aspects are evaluated, such as the design of structures of diverse materials and manufactured products in this region of Mexico. There is a case that is expressed at the end of a precautionary measure to reduce or avoid the presence of corrosion in the main materials used in this area of the country. It is the introduction of a contaminant into a natural environment that causes instability, disorder, damage or discomfort in an ecosystem, in the physical environment or in a living being. The pollutant can be a chemical substance, energy, such as sound, heat, or light. The contaminants, the contaminating element, can be a foreign substance, energy, or natural substance, when it is natural it is called a contaminant when it exceeds normal natural levels. It is always a negative alteration of the natural state of the environment, and generally, it is generated as a consequence of human activity. For the contamination to be detectable, the contaminant must be in quantity or For the contamination to be detectable, the contaminant must be in sufficient quantity or concentration to cause that detectable imbalance in the medium[5].

Atmospheric pollution

It is called atmospheric pollution or environmental contamination to the presence in the environment of any agent (physical, chemical or biological) or a combination of several agents in places, forms and concentrations such that are or may be harmful to health, for the security or for the welfare of the population, or that may be harmful to plant or animal life, or that prevent the habitual use of the properties and places of recreation and the enjoyment thereof. Environmental pollution is also the incorporation into the receiving bodies of solid, liquid or gaseous substances or mixtures of them, whenever they unfavorably alter the natural conditions thereof or that may affect the health, hygiene or welfare of the public[6].

The proliferation of polluting agents is related to mass consumption, the massive consumption of fossil fuels increases the greenhouse effect, and increases the possibilities of oil spills due to the greater need for fuels, the plastic being not biodegradable accumulates on land and in the Sea (as marine debris), industrial wastes are usually the result of accidents or a control of the damage that atmospheric corrosion can cause to the environment to industries. Liquid agents include sewage, industrial waste, spills of petroleum-derived fuels, which basically damage the water of rivers, lakes, seas and oceans, and thereby cause the death of various species. All pollutants come from a specific source and can cause respiratory and digestive diseases. It is necessary for human society to become aware of the problem. The presence of indoor and outdoor air pollutants, influenced by several factors, has a negative effect on metallic materials. These factors include emissions from anthropogenic and natural sources of indoor and outdoor processes, meteorological and ventilation conditions; as well as the processes of degradation and elimination of contaminants. Indoor air quality is a reflection of the quality of outdoor air. Several methods have been developed for indoor air measurements, indicating that sulfides and chlorides combined with humidity and temperature variations are the main factors in the generation of aggressive indoor environments of industrial plants that cause corrosion in metallic materials[7, 8]. The sulfides coming from the outside, penetrate through cracks, holes and air conditioning systems, while the chlorides come from aerosols in the environment, in addition to particles formed by cleaning activities on surfaces and bathrooms of industrial plants and vapors of fluxes from the processes of welding. The operations of industrial furnaces, emanations from materials for construction and chemical processes, are less significant in the aggressiveness of indoor environments. Changes in relative humidity in the range of 40% to 90% and temperatures ranging from 0 ° C to over 35 ° C, combined with concentrations of air pollutants such as sulfides, which exceed the standard air quality standards, generate corrosion. The particles and polluting gases deposited on metal surfaces of electronic micro components come from industrial processes of the various companies in the locality, areas with high levels of air pollution due to the large vehicular traffic, warehouses, offices and areas where they originate humid environments. For example, sulphidation of silver by H_2S originates in dry areas and humid environments. When humidity levels are greater than 70% what is known as wetting time. The five cases mentioned are explained below[9].

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New methodology based on the VEGAM matrix

This new methodology was elaborated and applied with the base of the VEGAM matrix, which is an alphanumerical matrix used to evaluate sections of areas required to determine by quadrants the location of components or devices of any type[5]. The VEGAM matrix is explained below:

A) VE (Veer). It represents the section observation process to observe the parts quickly and analyze the activities of interest.

B) G (Guiar). Indicates the way to evaluate the sections guided by the established alphanumeric matrix.

C) A (Analizar). It is part of the analysis to quickly detect sections that can generate failures or be different in an activity of interest.

D) M (Mejorar). It represents the way to improve easily and quickly, the improvements to be elaborated in the activities of interest evaluated with the alphanumeric matrix.

II. Methodology

The evaluation of methodologies for the environmental analysis in the electronic industry of Mexicali has led to the generation of new procedures developed by expert personnel from the industrial engineering area of the Technological Institute of Mexicali. These new procedures are based on conceptual, methodological, human and top management factors of the electronic industry of this arid zone.

The conceptual ones represented the theoretical knowledge required to elaborate the analysis of a need to be evaluated. The methodological ones indicated the methods, techniques, strategies and procedures to be used to carry out the development of the analysis and the proposed solution. Human competences showed the communication and interaction skills with the colleagues of the research team, as well as the organization of the activities to be developed. And the top management was of and self-reaction for the analysis and solution proposal, as well as the decision making to obtain the solution of the event to analyze. For the development of the research project in the electronics industry, it was necessary to develop laboratory-level experiments and then be applied in the electronic industry evaluated, in a fast and efficient way, because the company had to quickly solve a problematic situation it presented itself and generated losses of thousands of dollars per day.

III. Results

Use of the VEGAM matrix

Figure 1 represents an electronic board damaged by corrosion and poorly evaluated by the technicians and engineers of the company, causing economic losses. To solve the situation, the methodology was applied by competences with the young researchers and participating research professors. The methodology by competences was of great help for the immediate solution required that had very concerned the operative, specialized, managerial staff and owners of the evaluated company. In this study was used the MatLab software by the specialists[10].

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Figure 1 Electronic board with an electronic device damaged by corrosion.

Information from: http://reparatarjetas.blogspot.mx/p/reparacion-de-tarjetas-electronicas.html

One of the ways to identify electronic devices and systems damaged by corrosion in electronic boards (figure 1) is the use of the VEGAM matrix methodology to create a simulation of what happens in the manufacturing processes of the electronic industry. Mexicali, where were evaluating the environmental factors, that both climatic and air pollution as sulphides and nitrogen oxides mainly. In the research, the methodology with the matrix mentioned above was applied to an analysis situation presented in an electronic industry. The research activities at environmental chemistry level included the evaluation of climatic factors and air pollution from abroad, as well as those generated in the company in question for time, daily, weekly, monthly and seasonal periods of 2016 to 2017. Using said martiz, the solution was more feasible and quick, which led to the reduction of failures of the equipment and machines of the electronic industry evaluated. The acronym VEGAM explained above, was developed by an expert in corrosion and materials (Dr. Gustavo Lopez Badilla), during his research process at UNEA University in the years 204 to 2015. The methodology with the VEGAM matrix, has been tested in Several occasions and can serve not only for the electronics industry, but for any other type of industries or educational, medical, space, aerospace, marine, submarine, livestock and agricultural activities.

The analysis of electronic boards in the electronics industry generates costs and it is necessary to evaluate those equipment and machinery when they are in operation, so it is necessary to stop their operation. This can diminish the operative performance of the equipment and machines of the industrial plants. When this occurs, salaries stagnate and economic profits are not generated, and there is disagreement among operational, specialized and managerial personnel. In the industrial plant where the study was developed, with economic losses of 20%, the new methodology was applied with a matrix, to reverse the losses and generate profits in a period no longer than three months. The support of the researchers and the operative, specialized and managerial personnel of the company contributed to a one year change in the financial situation drastically, from losses to economic gains of up to 30%.

Use of the VEGAM matrix in the electronic industry

In the case of the electronics industry, it can be used to determine sections of electronic boards with the aim of detecting electrical failures and defective electronic components and determining which electronic boards are in operation and not functioning and which is easier and faster to detect the damaged sections.

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The electronic boards are divided into a maximum of ten sections classified with the alphanumeric system (letters A to E and numbers 0 to 5, interlaced with each other, in the form of a numerical matrix). This system has been applied in various analyzes in the electronics industry when evaluating the presence of corrosion and its effect on the functionality of electronic components of electronic boards in activities of detection of electrical faults, rework of electronic boards to locate defective electronic components to be Replaced by electronic devices in good condition. The VEGAM technique has been tested on several occasions and can be used not only for the electronics industry but for any other educational, medical, space, aerospace, marine, submarine, livestock and agricultural industries or activities. The analysis of electronic boards in the electronics industry generates costs and it is necessary to evaluate those equipment and machinery when they are in operation, reason why it is necessary to stop its operation[9]. This can reduce the operational performance of equipment and machines of industrial plants. When this happens, salaries are stagnant and economic profits are not generated, and there is nonconformity in the operational, specialized and managerial personnel. The VEGAM matrix is shown in figure 5, as an example of an operation analysis of an electronic board of an industrial system.

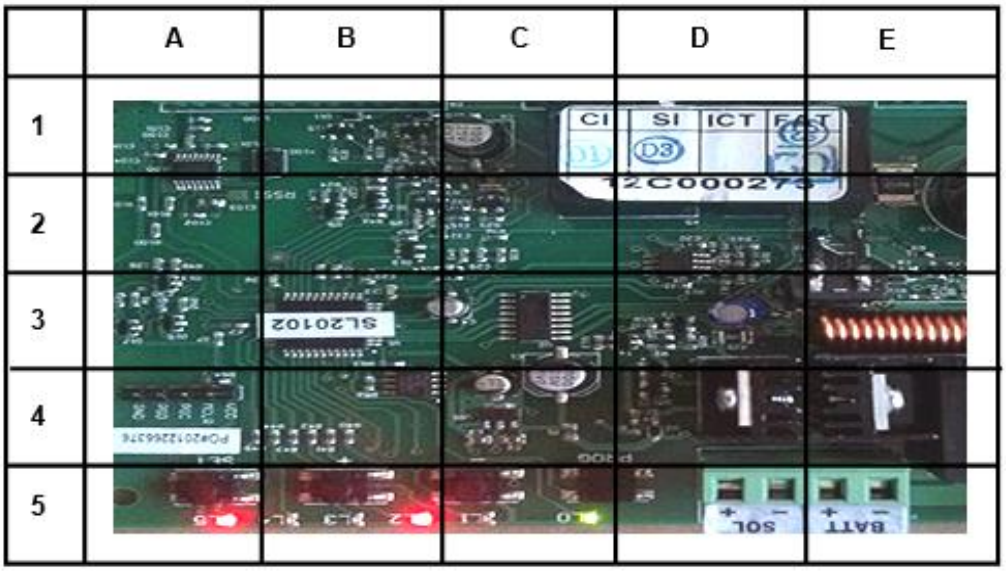

Figure 2 Analysis of functionability of electronic board with the VEGAM matrix (Invented by Dr. Gustavo Lopez Badilla-Specialist in corrosion and materials in the electronics industry and applied to other type of industries)

Figure 2 shows the sections divided as alphanumerical matrix from A to E letters and 1 to 5 numbers to detect very fast and easy the electrical failures in the electronic board that not have good functionability. This was made with the AFEM method used in this investigation. This VEGAM matrix used before in the detection of electrical failures in electronic boards was applied to each step of the manufacturing processes of the electronics industry evaluated.

Mathematical simulation

The evaluation of numerical data was made with the MatLab software that was applied to analyze the mathematical information with simulations and statistical methods used in the evaluation of the manufacturing processes.

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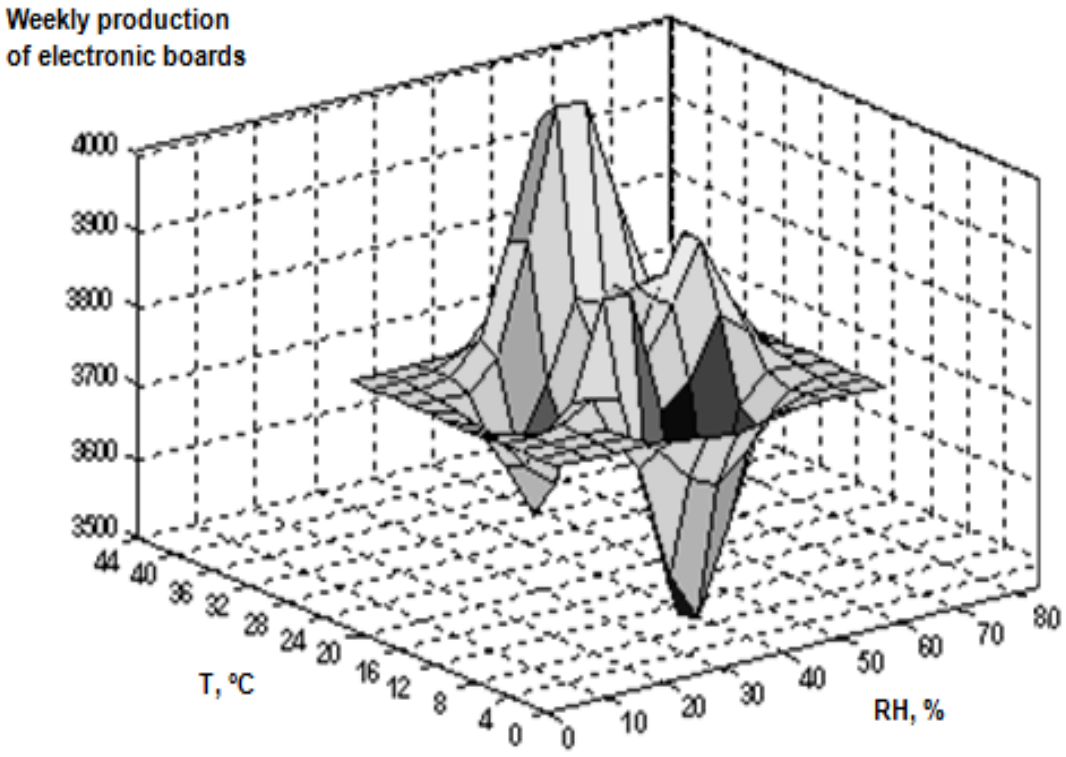

Figure 3 Analysis of the production levels and the climatic factors in the electronics industry evaluated in 2016.

In the previous figure we present a mathematical simulation of the effect on climatic factors such as temperature and relative humidity in the interior of the evaluated company. It is observed that as the temperature increases close to 40 ° C and relative humidity values in the order of 60%, the productivity indexes increase, but at levels above or below these, the productivity ranges are presented decreases, being an important factor of analysis, these climatic parameters. The white surface indicate that the correlation analysis if from 0 to 35, the gray surface shows a correlation analysis from 36 to 75 and the black surfaces are from 86 to 100.

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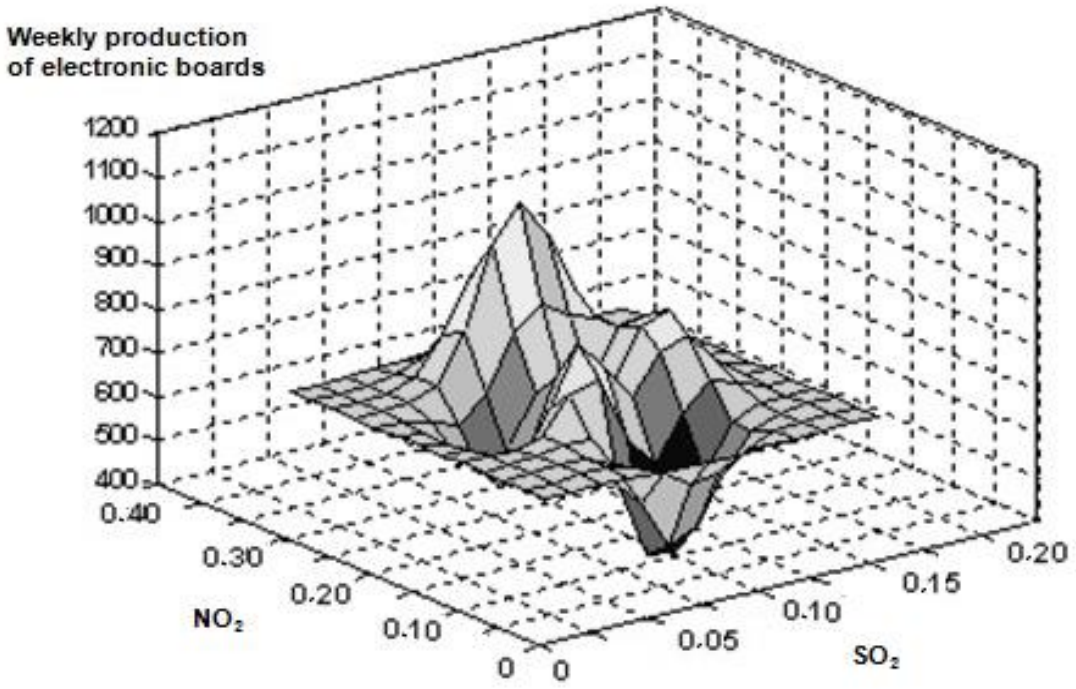

The figure 4 represents the relationship of the production levels where the relation between the air pollutants evaluated (SO_2 and NO_2) is observed, monitored with a specialized OMEGA DM DVTH equipment. The relationship shows that at approximate levels of 0.30 of NO_2 and 0.10 of SO2, the productivity indexes are maximum, even though the NO_2 levels are higher than the air quality standards proposed by the Environmental Protection Agency (EPA). This means that SO_2 has a greater effect on productivity levels, because at higher rates than the air quality standards, this productivity decreases. The white surface indicate that the correlation analysis if from 0 to 35, the gray surface shows a correlation analysis from 36 to 75 and the black surfaces are from 86 to 100.

IV. Conclusions

With the proposal of the new methodology with the VEGAM matrix, favorable results were obtained economically in the evaluated company. In the industry there are many activities where there is a great diversity of devices and electronic systems used in industrial equipment and machines.

This can generate an infinity of failures in the equipment and industrial machines due to the effects of environmental chemistry, loss of time and big costs for the company, but with the VEGAM matrix used, great economic savings were generated. The application of the novel methodology applied is of great importance because they increase the possibilities of developing new ideas in the electronic industry, and in other types of industries such as aerospace, food, space, industrial, medical, technology and others related to the manufacture and saving of energy, inputs or operative personnel and even to avoid economic losses. In this investigation it was found that by decreasing manufacturing times by the use of the proposed new methodology, where the evaluated company decreased its losses, even registering profits. Therefore, its use in the type of industry evaluated and in other industries is recommended.

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