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Evaluation of Sick Building Syndrome and Healthy Nutrition and Operative Yielding in a Plastics Industry of Tijuana, Baja California, México

ENF ECI Ángel Antonio Colorado Rodríguez[1], Hugo Lee Martinez[2], Denise Lee Garibi[2], María Elena Garibi Chapula[2], Carlos Raúl Navarro González[3], Luis Andrés Mondragón Chavero[4], Rosa María Duque Sevilla[5], María del Carmen Corral Nuñez[6], Gustavo López Badilla[6,7], Freisy Romely[6], Ana Karen Villaseñor Alemán[7], Eladio Naveja Farias[6,8]

[1]Profesor de Campo Clínico en UABC-Universidad Autónoma de Baja California en Valle de las Palmas, Tijuana, Baja California, México.
[2]Departamento Ergonomía Aplicada, Ergomedical de México, Astrónomos 13802, INDECO Universidad, Tijuana, Baja California, México.
[3]Departamento de Ingeniería Industrial, Universidad Autonoma de Baja California, Mexicali, Baja California, México.
[4]Departamento de Ingeniería Industrial, CETYS Universidad, Tijuana, Baja California, México.
[5]Departamento de Ingeniería Industrial, Tecnológico Nacional de Mexico, Instituto Tecnológico de Tijuana, Tijuana, Baja California, México.
[6]Departamento de Ciencias Aplicadas, Instituto Internacional para el Desarrollo Empresarial (INIDE), Tijuana, Baja California, México.
[7]Departamento de Ciencias, Secundaria Federal Emiliano Zapata No. 32, Valle Las Palmas, Campus Tijuana, Baja California, Mexico.
[8]Departamento de Ciencias Aplicadas, Escuela Colegio Alemán Cuauhtémoc Hank, Tijuana, Baja California, Mexico.

Abstract - The presence of the Sick Building Syndrome (SBS) in industrial companies and any type of closed surface as indoors of buildings, is very concerned, because can causes a mild or severe healthy symptoms, being the principal the respiratory diseases, which originates from discomfort to breathing problems (such as asthma), and generating critical situations for workers in industrial companies. This anormal action, can reduce their operational performance and cause errors, defective manufactured products and economic losses to large industries, such as the one that supported the development of this scientific study, and which is located in the city of Tijuana. The SBS is for the presence of microorganisms at microscale as RNA virus of the Orthomyxoviridae family and the Influenzavirus genus, being relevant in the generation of influenza in people and other respiratory infections with a great effect on the health of the population of Tijuana and around the world. This scientific study was made to evaluate the negative effect of the SBS and the operative yielding of workers and the productivity and quality levels, being important in the economic factors of any type of industry in the world. This investigation was made in 2023.

Keywords: SBS, plastic industry, operative yielding, respiratory diseases.

1.INTRODUCTION

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The Sick Building Syndrome can generate some diseases, being essentially acute respiratory illness (ARI) in closed places, especially industrial plants that are installed in a lot places around the world. This relevant aspect originates a negative effect in diverse persons that works in the industrial process, and can reduce his operative yielding, and with this the productivity and quality indices in the areas where are presented this health symptom. The SBS, is very evaluated in all industrial companies, to reduce or avoid the presence of ARI in workers of the manufacturing areas. Figure 1 show the principal negative effects of the presence of SBs that originates the ARI in closed places of industrial companies, being the sleepiness, tiredness and flu; and with this the operative yielding decrease in sometimes operative personnel can't work.

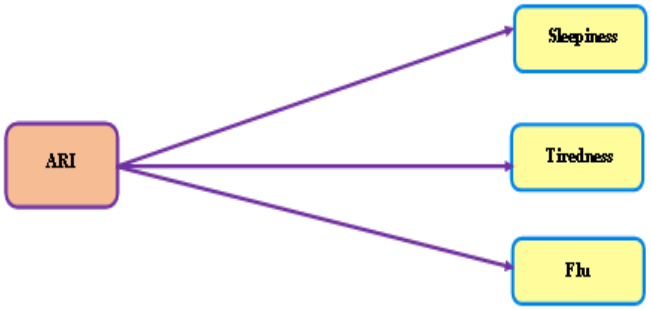

Fig -1: Essential types of negative effects of the ARI presence in workers of manufacturing areas
Source: Analysis of investigation

1.1 Plastics Industry in Tijuana

This type of industry is very important at worldwide, where are fabricated diverse type of plastic products, utilized in some activities as in houses (kitchen, bath, rooms and others place of homes), healthy actions (hospitals, medical centers and other places where attend injured people), industrial companies in different administrative and manufacturing areas, and any place of the daily life of any type of activities. In table 1 is showed the main plastic products and the type of actions.

Table -1: Principal plastics products of the plastic industry of Tijuana (2023)

Relevant Aspects / Activities	Products	Function	Reuse
Educative	Accessories, pens, plastic tools	Educative actions	Can be reused in administrative activities with less actions
Homes	Accessories, Food recipients, Plastic tools	Homes actions	Can be reused in domestic activities with less actions
Industries	Accessories, Industrial recipients, Plastic tools	Industry actions	Can be reused in industry activities with less actions
Medical	Accessories, Medical recipients, Plastic instruments	Medical actions	Can be reused in medical activities with less actions

Recreative	Accessories, Recreative recipients, Plastic instruments	Recreative actions	Can be reused in recreative activities with less actions

Source: Analysis of investigation

1.2 Sick Building Syndrome

This syndrome is very occurred in industrial activities, principally in closed areas, where not have ventilation, generating difficulty breathing, headache, drowsiness, fatigue and flu of workers of industrial processes of any type of industry in the world. Also, the SBS can causes discomfort in operative personnel of manufacturing areas without ventilation systems, for the presence of air pollutants and variations of temperature and relative humidity, with ranges out of the standard levels. In table 2 is presented the principal aspects that generates the SBS.

Table -2: Essential factors of generation of the SBS in a plastics industry of Tijuana (2023)

Relevant Aspects Factors	Sources	Consequences
Indoor Air pollution	Dust and chemical agents	Generation of ARI
Artificial Perfumes	From workers, especially of womens	Generation of ARI
Poor or inappropriate and even excessive lighting.	Bad electrical connections or bad installation	Generation of ARI
Absence of natural light and performing activities with 100% artificial	Bad ventilation	Generation of ARI
Poor heating or cooling of rooms and/or ventilation	Bad ventilation and bad climatic conditions	Generation of ARI
Poor positioning of heating and air conditioning systems	Bad ventilation and bad climatic conditions	Generation of ARI
Poor or great acoustics	Bad ventilation	Generation of ARI
Poor furniture and equipment designs (e.g. PC monitors, photocopiers, etc.).	Bad ergonomic factors	Generation of ARI
Poor ergonomics	Bad ergonomic factors	Generation of ARI
Chemical contamination	Bad ventilation and uncontrol of air polluton	Generation of ARI
Biological contamination	Bad ventilation and uncontrol of air polluton	Generation of ARI

Source: Analysis of investigation

1.3 Plastic Manufacturing Activities

There are many types of industrial process in the plastic industry where are utilized different flow production processes and diverse industrial operations and industrial equipments and machinery, with high technology. In table 3 is illustrated the diverse types of plastic products manufactured in the plastic industry where was made this investigation and the different flow production processes.

Table -3: Main plastics products manufactured and diverse flow production processes in a plastic industry of Tijuana (2023)

Flow Process Products	Types	Advantages	Disadvantages
Plastic bottle water	Lineal, G-Line	High productivity quality	Specialized personnel
Plastics hoses to cars	Lineal, T-Line	High productivity quality	Specialized personnel
Plastics hoses to aircrafts	Lineal, U-Line	High productivity quality	Specialized personnel
Plastic cover to cell phones	Lineal,	High productivity quality	Specialized personnel
Plastic covers to electronic clocks	Lineal, G-Line	High productivity quality	Specialized personnel

Source: Analysis of investigation

2. METHODOLOGY

This scientific study was made to determine the necessity to evaluate the SBS and its consequences, where are elaborated with the next activities:

a) Evaluation of atmospheric factors (air pollution and climatic parameters).

b) Analysis of operative yielding of ten workers and five industrial machines of a industrial line.

c) Evaluation of productivity and quality levels.

3. RESULTS

The investigation showed relevant information that is presented in the next sections and was very important to improve the operative yielding of ten workers and five industrial machines of manufacturing areas evaluated.

3.1 Analysis of Environmental Factors in Indoors of the Plastics Industry of Tijuana

An evaluation of the atmospheric factors was made to determine the effect of this relevant parameters in the generation of the SBS in the industrial plant, where was made this scientific study, and is showed in table 4.

Table -4: Evaluation of atmospheric parameters that generated the SBS in a plastics industry of Tijuana (2023)

Parameters	Air Pollutants, ppm				Climatic Factors	
Months Average	Cl-	CO	NO_X	SO_2	RH, %	T, °C
January	129	43	18	16	63	19
February	99	32	9	9	44	26
March	95	29	8	8	42	27
April	90	27	7	7	40	26
May	88	26	8	6	39	25
June	93	25	7	5	37	24
July	86	23	8	6	40	26
August	80	25	6	7	42	27
September	86	27	9	6	45	28
October	87	30	10	7	43	29
November	92	32	8	6	40	26
December	94	28	9	8	41	24

Cl-, Chloride Ions, CO. Carbon Monoxide, NO_X. Nitrogen Oxides, SO_2. Bioxide Sulphur, RH. Relative Humidity, T. Temperature

Air Quality Standards: Cl-, 100 ppm, CO= 35 ppm, NO_X= 10ppm, SO_2= 7.5 ppm, Average=45%, Temperature Average = 25 °C

Table 4 represents the behavior of the air pollutants in indoors of the plastic industry evaluated, indicating that from the second month of this investigation, all atmospheric factors were controlled by specialized filters and sensors to the air pollutants, which were penetrate from outdoors environments and some industrial operations of indoors of the industrial company, where was made this scientific study. And climatic factors were controlled by air conditioning systems.

3.2 Evaluation of Respiratory Diseases of Workers

This part of this scientific study was evaluated the presence of the ARI from the beginning of the investigation to the end in 2023, and is presented in table 5, and correlated with air pollutants and climatic factors, and represented by percentages of the presence of ARI.

Table -5: Correlation analysis of presence of ARI with atmospheric parameters in plastics industry (2023)

ARI, %	Air Pollutants, ppm				Climatic Factors	
Months Average	Cl-	CO	NO_X	SO_2	RH, %	T, °C
January	68	70	69	66	72	70
February	56	58	54	55	57	59
March	51	50	52	54	53	51

April	47	48	44	48	49	50
May	42	38	39	33	36	37
June	36	34	34	37	34	33
July	30	29	28	26	25	29
August	24	25	21	20	28	24
September	22	24	25	22	23	21
October	19	20	18	22	21	20
November	17	19	17	19	15	17
December	14	15	16	15	14	16

Cl-, Chloride Ions, CO. Carbon Monoxide, NO_X. Nitrogen Oxides, SO_2. Bioxide Sulphur, RH. Relative Humidity, T. Temperature

Air Quality Standards: Cl-, 100 ppm, CO= 35 ppm, NO_X= 10ppm, SO_2= 7.5 ppm, Average=45%, Temperature Average = 25 °C

Table 5 shows the percentage of the presence of ARI, influenced by the apparition of atmospheric parameters (air pollutants and variations of climatic factors), observing that was decreased the ARI percentages, when was controlled the atmospheric factors.

3.3 Evaluation of Productivity and Quality Indices

This section shows in two tables the productivity (table 6) and quality (table 7) indices in the period of this scientific study, where was observed the increase of both production factors conforms advanced this investigation.

Table -6: Analysis of Productivity levels (2023)

Factor / Months	Productivity, %	Factor / Months	Productivity, %
January	67	July	85
February	76	August	87
March	81	September	86
April	80	October	88
May	84	November	90
June	85	December	92

Table -7: Analysis of Quality levels (2023)

Factor / Months	Productivity, %	Factor / Months	Productivity, %

January	65	July	84
February	69	August	87
March	73	September	86
April	76	October	90
May	79	November	91
June	80	December	94

4. CONCLUSIONS

This investigation supported to the specialized people who is in charged in ergonomics, manufacturing, security and maintenance departments, to improve the operative yielding of workers of the manufacturing areas and the industrial equipments and machinery utilized in the fabrication of the plastic products mentioned above. This was relevant to obtain high levels of productivity and quality and with this, was obtained great economic gains in the plastic industry where was made this scientific study. With this, workers and industrial equipments and machinery were working with a high operative yielding.

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