Clean Technology and Industrial Safe: A Right of Society

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***Abstract*– In the last ten years industrial society has been confronted with chemical accidents in various industries. The chemical accidents are broadly defined as uncontrolled release of significant amounts of toxic, explosive or flammable into the environment during the production, storage, operation, transportation and disposal of effluents. Usually result from internal factors such as failure of materials/equipment, operational failures or human errors, while external factors are attributed to natural disasters or acts of vandalism, terrorism, sabotage, etc. This paper aims to demonstrate the importance of the formation of critical consciousness technique in demand and the goal of formulating clean technologies that do not come against the interests of society, mainly focused on reducing industrial accidents, life cycle, environmental preservation and the reduction of power consumption.**

***Keywords*– Clean Technology, Industrial Accidents, Industrial Processes and Disaster**

I. INTRODUCTION

The future of the new industrial revolution environmentally viable, inevitably, will the control and discovery of new forms of production based on the functional direct and to produce less contaminants and consume less energy. The research probably enacts bankruptcy of traditional processes based on simulation programs and process control. New routes will walk in replacement industrial, processing equipment, and materials in the recycling and / or reprocessing of materials, equipment and processes, other similar features feasible, even result in costs more expensive.

There is no certainty that such certainty that such projective result in benefits, because the future is always unknown. It is likely to be intangible in the near future, not to mention that, at the gates of the threshold of the XXI century, little has been done and nothing is waving at a time when the physical-chemical phenomena are weather outbreak with no boundaries, no barriers, no specific standards, challenging the very fate of humanity on the brink of ecological collapse in the face of various industrial accidents that have occurred in metallurgical or chemical processes.

In view of Duarte [1] the accident can be considered as an undesirable event, fortuitous that, directly or indirectly, ends up creating problems to physical and mental integrity of persons, to the environment, to property, and may be restricted, large and can be measured quantitatively for the damages caused. Generally most of the accidents occur due to human error and equipment failures that these should be scrutinized by management guidelines, procedures and programs of inspections and preventive maintenance.

According to research conducted by Tolba [2] in the period 1970 to 1990 there were about 180 major industrial accidents, resulting in 8,000 deaths and 20,000 injuries. Among them may be cited the explosion occurred on July 10, 1976, at the chemical plant located in Seveso, Italy, affecting about 37,000 people and contaminating an area of 1800 hectares, which was under surveillance for six years. No deaths occurred, however, among the chemicals found were two kilograms of dioxin, an extremely toxic that could cause environmental damage proportions not evaluable.

One of the most famous and most embarrassing industrial accidents that have already occurred in the technological society was in Bhopal, India, in December 1984, the chemical plant of Union Carbide which killed more than 3,000 people and about 20,000 people living in surroundings of the industrial complex had eye problems and breathing. About 30 tons of methyl isocyanate, extremely toxic product used in the manufacture of pesticides, leaked suddenly in the night cometh home of the inhabitants who lived nearby [3], [4].

However, much time has passed, are numerous accidents that occur in industrial affecting, directly and indirectly, the people living in their surroundings. Moreover, the levels of contamination of toxic metals (Pb, As, Cd, Zn, Hg, Cr, and Cu) so as sulfur dioxide (SO_2) released daily in the environment are always traces left by complex industrial society contaminating. Values over the range of 40-60 mg/m^3 SO_2 increase the risk of respiratory diseases and ophthalmological diseases [3].

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The large factory complexes and industrialized countries are increasingly becoming complicit in a policy of self-interest and systemic, being in various situations against the interests of society, exacerbating accidents, deaths and contamination with consequences, direct and indirect, on public health of populations.

This paper aims to demonstrate the importance of the formation of critical consciousness technique in demand and the goal of formulating clean technologies that do not cause disorders in the interests of society, focused on reducing industrial accidents, life cycle, environmental preservation and reduction energy consumption.

II. METHODOLOGY

The development of this article was conducted from exploratory literature, drawn from books, journal articles, tutorials, legislation and National Standards and International, whose sources include query pages reliable electronic aiming to present a series of accidents in world and show the premises of cleaner technologies supported in the reduction of contaminants released into the environment.

III. INDUSTRIAL ACCIDENTS

According to He et al. [5] accidents hazardous chemicals are broadly defined as uncontrolled release of significant amounts of toxic, explosive or flammable into the environment during the production, storage, operation, transportation and disposal of effluents.

Methods of risk assessment, reflecting the trend to predict, plan and alert as industrial risks, would be more effective if it were possible to predict all possible events and more stringent and were founded assumptions and criteria of analysis.

Industrial accidents that provide a more significant learning are the most traumatic for workers and the environment, especially when fatal victims occur, and also those that affect drastically the populations that inhabit the surrounding industrial facilities.

Aiming to have a vision of this scenario are presented below, a summary of a series of accidents that occurred leaking toxic gas released into the atmosphere by the media over the past ten years.

A. Ammonia pipe explosion downs 90 in Zaboanga City, Philippines, 01/03/2012, [6]

Police said the ammonia pipeline that exploded in the city of Zamboanga, Philippines, was probably hit by a hard disk of a rotating machine operated by a worker and consequently led to the formation of fissures or cracks in the external surface of the tube. From that point there was a strong ammonia gas leak causing the hospitalization of about 90 people. The ammonia (NH_3) has a very strong smell and can compromise the respiratory system of people

The Figure 1 shows the removal of people affected by ammonia gas to the public hospital.

Fig. 1. Transportation of person affected by NH_3 to hospital [6]

B. Gas leak toxic refrigerator Bataguassu (MS, Brazil) killed four people this morning, 28/02/2012, [7]

The leak of toxic gas recorded this morning (February 31, 2012), the tannery Frigorific Marfrig, in Bataguassu killed four people working on site. The gas would Chloramine started leaking highly toxic and contaminated about 50 people. Initially victims were sent to the Central Hospital. According to information from the Commander of the Fire Department, four people died when arriving at the city hospital, and four were in serious condition and were taken to hospitals in Três Lagoas and Presidente Prudente (Brazil). Commander of the Fire Department reported that the BR 267 (highway) is banned, because the gas can be inhaled by drivers. The tannery is on the banks of the city's main road. Also according to the Commander continued leaking gas and failed to contain the leak.

C. Toxic gas leaks from Shanghai chemical plant, 28/09/2011, [8]

Tuesday afternoon, large yellow toxic fumes of NO and NO_2 leaked from a tower of nitric acid (HNO_3) located on petrochemical plant in Shanghai. Company sources said the security measures were immediately taken, because the gas can irritate the lungs and lower resistance to respiratory diseases. There were no casualties in this event however probably the inhabitants of the vicinity of the plant were affected by the spill of nitric gases. The company was fined nearly $ 31,000.

D. Huge toxic gas leak in Russian City, 02/09/201, [9]

In Chelyabinsk (Russian) occurred a violent gas leak bromine (Br_2) during transportation by train. The gas was being transported in glass containers when the breakage occurred. Bromine is an extremely toxic gas can affect and cause irreparable damage to the kidneys and brain. It was not explained the use and transportation of this gas held in glass containers.

E. Gas leak in Bulgaria's Debelets town stirs panic, 12/07/2011, [10]

On Monday, about 2,000 residents living in the vicinity of the accident were evacuated from the center of Bulgaria when a tanker truck, a Turkish national, born styrene, fell on a road near the town of Debelets. The spill formed a toxic cloud that spread across the city forcing rapid evacuation of residents due to the toxicity of styrene. Styrene was intended for a plastic factory.

Figure 2 shows the action of firefighters working on the tanker truck crashed loaded with styrene.

Fig. 2. Launch foam by firefighters injured in tanker truck loaded with styrene [10]

F. Alagoas (Brazil): Brasken disrupts the production of chlorine plant and tries to discover the causes of the accident, 24/05/2011, [11]

On Saturday night, residents of a community in Trapiche, situated close to the industry they heard several explosions and then a large gas leak. The leak with a strong chlorine odor caused panic in the residents living nearby factory. The removal service and fired 130 people, including adults and children, had to receive medical treatment in hospitals with respiratory symptoms of intoxication.

All reported having shortness of breath, malaise, vomiting, fainting, coughing and fatigue. Residents said some of intoxicated would have vomited blood. Braskem said through a statement that the unit Chlorine-Soda in Maceió, Alagoas, (Brazil) is disabled by the company's decision and that no other leak has been detected since the first event.

The company said it continues to work to identify the causes of the accident and who is collaborating with the competent authorities to clarify the two incidents reported since Saturday.

G. Toxic gas leak kills three in Uttar Pradesh, 30/01/2011, [12]

Three people were killed while 12 others were hospitalized after a toxic gas leak from an unknown chemical plant located in the district of Hardoi, Uttar Pradesh, India.

H. Poison gas leak kills DuPont worker, 06/04/2011, [13]

A worker belonging to DuPont plant, located in Charleston (West Virginia), United States, died after being hit in the face by a strong gas leak toxic and flammable methyl chloride used in the manufacture of herbicides. Seven hours later, another worker in the production of polyurethane also died in hospital after being hit by strong phosgene leak, extremely toxic and corrosive gas.

Figure 3 shows the Du Pont factory located in Charleston (West Virginia), United States where there were leaks of toxic gases.

Fig. 3. Du Pont factory located in Charleston [13]

I. Four in hospital after toxic gas leak, 05/03/2010, [14]

A serious accident with leak of titanium tetrachloride ($TiCl_4$) used in industrial processing in a factory titanium products located in England, near the River Humber, gassed and burned four workers employed at the time of the accident.

The factory reports that the accident occurred was controlled. In addition, the factory stated that no intoxications occurred with the locals who inhabit the area.

J. 4,000 evacuated after toxic gas leak in Columbus, 14/12/2009, [15]

A leak of hydrogen sulfide (H_2S), an extremely toxic gas leaked at a recycling plant used lubricating oil, located in Ohio, Columbus. United States, resulting in the evacuation of 4,000 people who worked at the factory, as well as the people who were in commercial areas surrounding the treatment plant used oil. According to a statement given by the chief financial officer, the leak of hydrogen sulfide occurred due to a power outage that caused, indirectly, the rupture of a gasket in a pump. The problems of leaks occurred when the process was restarted.

The pictures presented in Figure 4 shows aspects of the industrial plant at the time of leakage of toxic gas.

Fig. 4. Aspects of leakage of H_2S in lubricating oils refinery [15]

K. *Lanzhou successfully chemical leak*, 28/02/2008, [16]

On Thursday, February 28, 2008, there was an ammonia leak in tank trucks with 20 tons of liquid ammonia that could explode and cause major environmental contamination in the city of Lanzhou, China. The emergency plan was executed with rapid evacuation of about 1,200 people living in places near the treatment plant.

We conducted rapid cooling with water from tanker trucks containing liquid ammonia to prevent an accident of major proportions.

The photos in Figure 5 show the cooling water of the tank cars containing liquid ammonia.

Fig. 5. Cooling with water ammonia tank cars [16]

L. *Chlorine leak poisons worked 59 in Shanghai,* 12/03/2007, [17]

On March 12, 2007, leaks of chlorine gas (Cl_2) from pressurized cylinders of liquid chlorine, stored in a chemical factory deactivated, located on the pier near the Huangpu River, victimized a group of 59 workers who were dismantling the equipment old.

The workers were quickly taken to hospitals with respiratory problems and optician. The hospital reported that eight workers were hospitalized with serious injuries.

Figure 6, below, shows the action of firefighters deactivated in the factory where chlorine leak occurred at the factory deactivated.

Fig. 6. Team firefighters in chlorine leak [16]

M. *40,000 Chinese evacuated from explosion 'Death Zone,* 2003, 27/12/2003, [17]

In this Saturday, December 27, 2003, near the town of Gaoqiao in Kaixian County, China, rescuers continued to search for survivors and more bodies after the toxic cloud, consisting of methane (CH_4) and high sulfide levels hydrogen (H_2S), from an explosion of a natural gas well dispersed in the surroundings of the city forcing the evacuation of about 40,000 inhabitants. Children and old died due to the passage of the toxic cloud. Some sources reported more than 100 dead.

N. *Georgia-Pacific hydrogen sulfite (H_2S) release* 16/01/2002, [18]

On January 16, 2002 two workers were killed and eight wounded when they were exposed to the leak of hydrogen sulfide in the facilities of the Georgia-Pacific mill Naheola, located in Pennington, Alabama.

A solution of sodium hydrogen sulfide (NaSH) is delivered daily by tanker trucks. Within twenty four hours previous 15 trucks had unloaded the product. It was found later that leaked into the industrial wastewater about 20 liters of each tank truck. On an operational error was released sulfuric acid to NaSH retained in sewage which resulted in the change of pH and consequently the rapid evolution of hydrogen sulfide (H_2S). Three workers fainted with the evolution of gas while the others tried to remove the victims, unfortunately, workers close to the tank truck quickly died.

The photos in Figure 7 and Figure 8 show the tankers near the H_2S leak.

Fig. 7. View of the tankers near the leak of hydrogen sulfide [18]

Fig. 8. The tankers near the leak of hydrogen sulfide [18]

IV. THE CLEAN TECHNOLOGY

Based on the description of various industrial chemical accidents that have occurred in the world in recent years it is a question critical to designers, managers, planners industries, researchers, teachers, etc.

- it is possible or feasible to chemicals that society needs effectively without disrupting the environment without producing undesirable byproducts new and significant reductions in sources of raw materials and energy required to industrial processes and industrial safety margin that does not compromise the life and health of workers and inhabitants of the regions surrounding the industrial complex?

It is believed that the same way that man built the actual technologies; it is also possible to change the direction of traditional technologies for producing goods making them directed more policies of the current society.

In view critical clean technologies or more correct should stand out from traditional technologies known when they meet the assumptions that involve sustainability in every way man, the environment, public health, worker safety, respect and safety of inhabitants surrounding industrial complexes, methods that reduce energy and programs that meet the new philosophies of reuse, reuse of raw materials in order to reduce the waste generated.

It is believed that the treatment or processing of waste should be carried out in their own generating source of pollution, because what we have observed is usually a great effort accompanied by high cost of treatment to recover the final system when in fact contaminated, the majority of analyzes shows that it must take care of the effluent contaminant at its source and not the end-of-pipe.

According to Berkel [19] is essential to the linking economic development assumptions imposed by environmental and social sustainability. The environmental sustainability of the industrial scenario is cleared when they are used from the fundamentals of ecological systems operating practices and metrics typically used in the company.

The eco-efficiency of production of chemicals can be defined based on the raw material, in process design, continuous improvement of the manufacturing process, maintenance, security, re-use and recycling and associated with the following themes: efficiency resources, emission of greenhouse gases, use of clean energy, and reducing water treatment and environmental impact of waste.

According Azapagic [20]) historically Life Cycle Assessment (LCA) was first applied to the products, however, with this technique, the development over time has usually been used to evaluate industrial processes, quantifying and evaluating environmental interventions options for improvement and sustainability throughout the life cycle of product-process.

The literature has shown a number of case studies indicating that the lifecycle analysis must be supported by considerations of environmental sustainability, including studies on indirect releases of pollutant concentrations in environmental systems, evaluation of raw materials and waste disposal.

The meaning of cleaner processes should be linked to implementing a strategy economic, environmental and technical, integrated processes and products, to increase efficiency in the use of raw materials, water and energy by not generating, minimization or recycling of waste generated, with environmental and economic benefits for the productive processes.

Work proposed by Seiffert [21] are also highlighted the importance of implementing the philosophy of cleaner technologies in reducing pollutants as a major concern of companies that think and organize themselves for the present and future.

In order to answer the initial question to construct the complex industrial chemical, petrochemical and metallurgical based on the fundamental principles of the present, not a particular order of priority criteria, but leaving processes are built based on common sense, and innovations in local policies, national or international, provided they are imperatively met or based on the following points:

- sustainable economic, environmental and social;
- reduction, reuse, treatment or disposal of waste,
- reducing or optimizing energy used in the industrial process;

- quality of products for possible contamination with toxic substances;
- ensuring the quality of life of workers and their descendants based on chemical studies, biochemical and toxicological substances used in industrial processing;
- evaluation and commitment to participatory management of industrial disasters with the inhabitants living nearby the plants, including the evacuation;
- personal safety and property security encompassing the equipment, instrumentation, utilities and industrial process technologies.

V. CONCLUSIONS

Given the facts presented, it can be concluded from the need to:

- articulate the integration of environmental agencies, public health, safety and industrialization with the Society organized to establish standards and procedures in order to ensure real quality of life;
- reassess and restructure industrial projects so that environmental, social, economic and political are identified in the planning phase of the project before the decisions are adopted deployments;
- reduce the space generation and storage of chemicals that may compromise the security of property developments;
- propose research where innovation to the use and reuse of chemicals for the significant reduction in effluent disposal;
- clarify and discuss extensively in engineering courses scenarios that promote chemical accidents and cause so much trouble to society;
- develop a critical consciousness technique, which should be constructed in society, especially in the University, in order to understand the routes manufacturing of products and contaminants generated and/or aggregates during processing industry, with a view to preserving the environment.

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