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# A REVIEW: CARCINOGENIC TREND IN PETROCHEMICAL INDUSTRIES

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***ABSTRACT:*** ***The use of chemical compounds benefits society in a number of ways. Different petrochemical products or by products has always been beneficial. Yet, at times, these benefits are offset by certain disadvantages, notably the toxic side effects of the chemical compounds used. Exposure to these compounds can have varying effects, ranging from instant death to a gradual process of chemical carcinogenesis. There are three stages involved in chemical carcinogenesis. These are defined as initiation, promotion and progression. This cause genetic modification such as mutations in genes that control cell proliferation, cell death and DNA repair. Different experiments were carried out, to check the probable carcinogenesis of substance, on animals, in laboratory and on human cells. Exposure limits of different substance were listed by various government agencies. If the proper caution, safety measures and precautions are taken then, it will help us to minimize the risk of getting affected by carcinogens.***

***Keywords: Carcinogen, Petrochemical industries, mechanism, exposure limits***

## I. INTRODUCTION

Emissions from industrial plants may give rise to both annoyance and concerns about serious health effects. In the petrochemical industry, potentially harmful substances are produced or used and some are toxic, foul smelling, or flammable. Several reports show increased risk of cancer and low birth weights in populations living close to petroleum-polluted areas [1].Stable petrochemical production may be associated with low, but long-term, exposure to industrial emissions. Cancer is the second among fatal diseases, next to cardiovascular diseases, in the industrialized countries and third fatal disease in India. Cancer is a broad term used for identifying a large number of diseases. Perhaps the only common feature of these diseases is the ability of uncontrolled cell proliferation that cannot be checked by the normal cell kinetics regulators. A normal cell suddenly turns into a rogue cell and start dividing continuously without check, leading to the development of solid lumps (tumors) or an abnormal rise in the number of dispersed cells like the blood corpuscles [2].

Cancer can occur in any part of the body and in any organ or tissue. Cancer originates in our own cells, but several factors, both intrinsic and external to the body, which influence our daily life, can add to the life time cancer risk. A cancer is made up of billions of cells, all originating from an initial cell which multiplies clonally, escapes to apoptosis and accumulates genetic (and/or epigenetic) alterations which converge into a neoplasic cell. Neoplasias can be classified as benign or malign depending on their cellular characteristics [3]. The constituent cells of a malign neoplasia show yet more changes in cell biology. They proliferate autonomously, differentiate themselves, invade adjacent tissues and frequently metastasize on tissues that are not related to the primary neoplasia .Cells, which are part of benign neoplasias, grow more slowly, and in general, they do not disturb normal tissue function, unless they compress vital structures. Exposure normally occurs through inhalation, skin or eye contact, and ingestion. These are known as the routes of exposure [3, 4].

**Inhalation:** A very important type of workplace exposure occurs when you breathe a substance into the lungs. The lungs consist of branching airways (called bronchi) with clusters

of tiny air sacs (called alveoli) at the ends of the airways. The alveoli absorb oxygen and other chemicals into the bloodstream. The surface area of a person's alveoli is roughly equal to that of half of a tennis court. Some chemicals are irritants and cause eye, nose, and throat irritation. They may also cause discomfort, coughing, or chest pain when they are inhaled and come into contact with the bronchi (chemical bronchitis). Other chemicals may be inhaled without causing such warning symptoms, but they still can be dangerous. Sometimes a chemical is present in the air as small particles (dust or mist). Some of these particles, depending on their size, may be deposited in the bronchi and/or alveoli. Many of them may be coughed out, but others may stay in the lungs and may cause lung damage. Some particles may be absorbed into the bloodstream, and have effects elsewhere in the body.

**Skin Contact:** The skin is a protective barrier that helps keep foreign chemicals out of the body. However, some chemicals can easily pass through the skin and enter the bloodstream. If the skin is cut or cracked, chemicals can penetrate through the skin more easily. Also, corrosive substances, like strong acids and alkalis, can chemically burn the skin. Others can irritate the skin. Many chemicals, particularly organic solvents, dissolve the oils in the skin, leaving it dry, cracked, and susceptible to infection and absorption of chemicals.

**Eye Contact:** Some chemicals may burn or irritate the eye. The eyes are easily harmed by chemicals, so any eye contact with chemicals (particularly liquids) should be taken as a serious incident.

**Ingestion (swallowing):** Chemicals can be ingested if they are left on hands, clothing, or beard, or when they accidentally contaminate food, drinks, etc.

The longer we are exposed to a chemical, the more likely we are to be affected by it. Chemical exposure which continues over a long period of time can be particularly hazardous because some chemicals can accumulate in the body or because the health damage does not have a chance to be repaired. The body has several systems, most importantly the liver, kidneys, and lungs, which change some chemicals to a less toxic form (detoxify) or eliminate them. If our rate of exposure to a chemical exceeds the rate at which our body can eliminate it, some of the chemical will accumulate in our body. Illness that affects the organs for detoxification and elimination, such as hepatitis (inflammation of the liver), can also decrease their ability to eliminate chemicals from the body. Accumulation may not continue indefinitely. There may be a point where the amount in the body reaches a maximum and remains the same as long as your exposure remains the same. This point will be different for each chemical. Some chemicals, such as ammonia and formaldehyde, leave the body quickly and do not accumulate at all. Other chemicals are stored in the body for long periods. For instance, polychlorinated biphenyls (PCBs) are stored in the fat. The effects of toxic substances may appear immediately or soon after exposure, or they may take many years to appear. An acute exposure is a single exposure or a few exposures.

Acute effects are those which occur following acute exposures. Acute effects can occur immediately, or be delayed and occur hours or days after exposure. Chronic exposure is repeated exposure that occurs over months and years. Chronic effects are those which occur following chronic exposures, and so are always delayed. Exposure limits are established by health and safety authorities to control exposure to hazardous substances [5]. Occupational Exposure Limits (OELs) are one of the major control instruments for workers' exposure to chemicals. Exposure limits usually represent the maximum amount (concentration) of a chemical which can be present in the air without presenting a health hazard. Permissible Exposure Limits (PELs) are set by the Occupational Safety and Health Standards Board, and enforced by the Division of Occupational Safety and Health.

## II. CARCINOGENESIS OF MATERIALS

Epidemiological studies determine the relationship between a cancer suspect chemical and a human population over a long period of time. Animal studies directly induce cancer in test animals using a large sample of animals, usually of two or more species with varying dose and time parameters. Experiments with animals are based on the premise that chemicals that produce cancer in animals will have similar effects on human cells. The Table 1 contains list of carcinogen and their exposure limits.

Table 1: List of carcinogens and their exposure limits

| No | Substance | 8 hour limit value (mg/m3) | Short term limit value (mg/m3) | Targets |
|---|---|---|---|---|
| **1** | Acetaldehyde | 45 | 90 | Kidney, respiratory system |
| **2** | Benzene | 1.5 | 9 | Blood cells ,Bone marrow(Leukemia) |
| **3** | Benzopyrene | 0.002 | 0.02 | Respiratory system(lungs) |
| **4** | 1,3-butadiene | 1 | 10 | Hemato cancer |
| **5** | Dioxane | 90 | 180 | Lungs,liver,kidney |
| **6** | Dichloro methane | 120 | 250 | Kidneys, lungs |
| **7** | Epichlorohydrin | 1.9 | 4 | Liver, respiratory system (nasal cancer) |
| **8** | Ethylene oxide | 2 | 9 | Blood,kidneys,respiratory system (leukemia) |
| **9** | Propylene oxide | 5 | 25 | Skin, respiratory system |
| **10** | Acetamide | 25 | 60 | Skin, respiratory system |
| **11** | Ethyl mercaptan | 1 | | Blood,liver,kidney |
| **12** | Ethylene dichloride | 45 | 90 | Kidney, liver (circulatory system cancer) |
| **13** | Vinyl chloride | 2.5 | 13 | Lymphatic system, kidney |
| **14** | Trichloromethane | 10 | | Skin, respiratory system, blood |
| **15** | Methanal | 0.6 | 1.2 | Respiratory system (nasal cancer) |
| **16** | Tetra chloroethylene | 70 | 170 | Respiratory system,liver,kidney |
| **17** | Polychlorinated biphenyls | 0.01 | 0.03 | Liver,kidney,blood |
| **18** | Acrylonitrile | 4.5 | 13 | Blood cell |
| **19** | Carbon tetra chloride | 13 | 19 | Liver(liver cancer) |
| **20** | Asphalt fumes | | 5 | Skin tumors |
| **21** | Benzene thiols | | 0.5 | kidney, liver |
| **22** | Benzyl chloride | | 5 | Skin, respiratory system |
| **23** | n-Butyl acetate | 710 | 950 | Skin, respiratory system |
| **24** | Caprolactum | 1 | 3 | Skin,liver,kidney |
| **25** | Carbon black | 3.5 | | Respiratory system(lymphatic cancer) |
| **26** | Catechol | 20 | | Respiratory system, kidneys |
| **27** | Cresol | 22 | | Pancreas, liver, kidneys |
| **28** | Cumene | 245 | | Skin , respiratory system |
| **30** | Diethyl amine | 25 | 75 | Respiratory system(lungs) |
| **31** | m-Dinitrobenzene | 1 | | Blood cells, liver |
| **32** | Ethyl benzene | 435 | 545 | Skin, respiratory system |
| **33** | n-Heptane | 350 | 1800 | Respiratory system |
| **34** | Hydrazine | | 0.04 | Liver,kidney,blood vessels |

## III. MECHANISM OF CARCINOGEN

Evidence for identifying cancer-causing substances comes from three sources: **human studies**, **animal studies**, and **laboratory experiments with human cells**. Evidence from each of these sources is important in helping public health officials make decisions about whether exposure to certain substances needs to be reduced or eliminated. The more information available, the more likely it is that they will be able to identify which substances are carcinogens. **Human studies** were carried out by taking into account the time of the exposure of workers towards respective probable carcinogens. Exposure to benzene causes leukemia and exposure to SBR causes lymphatic cancer were concluded by these experiments. In **animal studies** rats or mice were used as a subject. They were exposed to petrochemicals like 1, 3 butadiene and gasoline for varying time period so as to check the impact on their structure. Rodents were chosen because of their low life time and their response towards carcinogens is similar to human body. **Laboratory studies** were based on generation of human cells in lab and experimenting on them.

The mechanisms of carcinogens are categorized in three stages [12], initiation, promotion, progression. Changes in the genome's structure occur across the three stages of neoplasic development. Changes in gene expression also take place during the promotion stage, with selective proliferation of initiated cells and the development of pre-neoplasic cells. During initiation and promotion, apoptosis and cell proliferation can occur at different rate. During progression, this balance is modified and from there malignancy arises. Human life is led under very different conditions from these experimental procedures. Although the process of carcinogenesis is similar for man and experimental animals, the different chemical compounds to which humans are exposed throughout their lives alter the speed of the process and the frequency of mutation, the speed of cell growth and the phenotypical expression of the changed genes [2]. On the other hand, the individual's susceptibility and their defense mechanisms have their own interaction, which modifies each of the neoplasic stages.

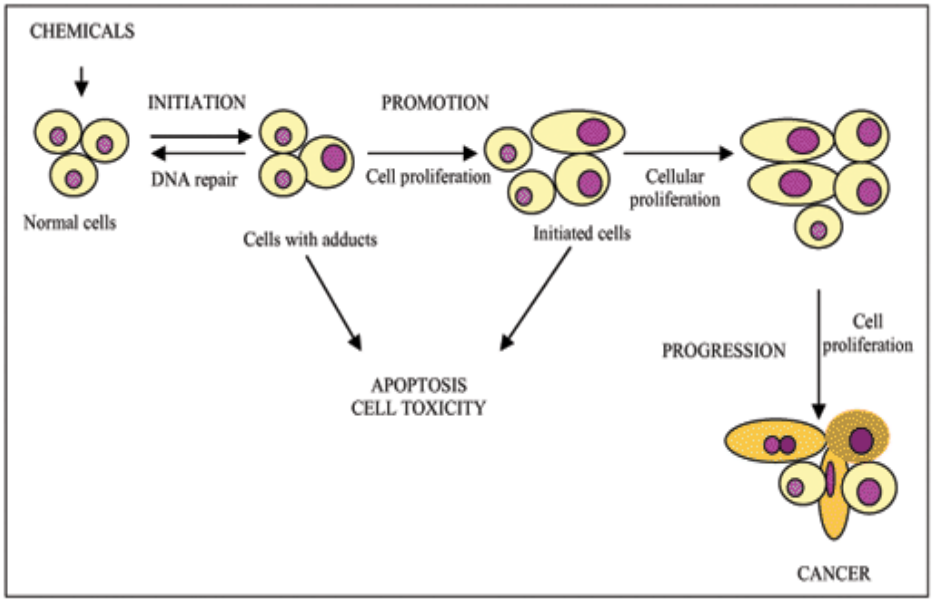


Figure 1: Stages of carcinogens

From above discussion we can say that the risk of cancer depends on a range of factors including the chemical, the exposure and the susceptibility of the individual who is exposed. If work with a carcinogen is required, work practices must carry out in accordance with relevant legislation and established best practice [14]. Those are risk assessment, record keeping, labels and signs, material handling, storage and transportation etc.

## IV. CONCLUSION

Cancer is the process of cell proliferation. From the above discussion we have come to know that just getting exposed to any toxic chemicals doesn't leads to cancer. There are some exposure limits set by NIOSH, OSHA and European Agency for Safety and health for workers working in such a hazardous place. If the organization imposes the strict safety rule and precaution regarding the same in the work environment, then the risk could be reduced. Proper storage and disposal of carcinogenic material must be available. Proper equipment design for such hazardous and toxic substance must be made with standard labels and signs on it. Personnel or workers must be well equipped with the PPEs. If the proper caution and precaution is taken, then the risk of getting affected or exposed from carcinogen will reduce.

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