Carcinogens are the “time bombs” of hazardous substances in the workplace. But many substances do not develop their deadly effect until years after exposure. It’s a risk for the worker that is often underestimated – and represents an enormous challenge for industrial hygienists. The good news is that occupational cancer can be prevented through monitoring and protective measures.

10 facts you should know about occupational carcinogens
1. **Cancer is a major health hazard in the workplace.**

Cancer in the workplace is twice as common as occupational accidents.

Every year, **660,000 deaths occur worldwide due to work-related cancer.**

2. **Plastic is a deadly threat.**

For many years, vinyl chloride was considered to be safe. This compound of carbon, hydrogen and chlorine is a raw material used in the production of PVC. In 1974, seven cases of severe (and very rare) liver cancer were found in individuals who worked at a PVC plant in Louisville, Kentucky. Five of the afflicted workers, all of whom had worked with vinyl chloride for 20 years, had already died.²

It is only because of the efforts of the National Institute for Occupational Safety and Health (NIOSH) and the energetic probing of a few scientists that the connection between cancer and vinyl chloride became known. The authorities reacted quickly: In 1974 OSHA established a threshold limit for vinyl chloride that was 500 times more rigorous than before. As a result, liver tumors in workers as a result of vinyl chloride exposure have not occurred since.

3. **Carcinogens are toxic to cells.**

Carcinogenic substances are a subgroup of toxic agents, which have the potential to cause cancer in living tissues. Carcinogen exposure can occur from the inhalation, ingestion, or absorption of many different types of substances in our bodies.

Carcinogens may increase the risk of cancer by altering cellular metabolism or damaging substances such as proteins, ribonucleic acids, and especially DNA directly in cells – which interferes with biological processes. This causes genetic abnormalities to develop in the normal cell. With cancer, cells go out of control, multiply without order, and invade and destroy the surrounding tissue. The changes in a cell’s DNA are called genetic “blueprint”. Some of these changes may be inherited from our parents and grandparents. If, and to what degree, a carcinogen actually causes cancer is highly dependent on each individual organism.
4. **Substances are acutely toxic at first, then carcinogenic.**

Exposure time is a critical factor for carcinogenic substances in the workplace. Most carcinogens do not develop their carcinogenic effect in a brief exposure. However, they can cause toxic effects in other ways. For instance, acute inhalation of chromium IV compounds starts by causing nausea, but can lead to caustic effects on the skin and mucous membranes.

For the threat of cancer to exist, long-term exposure to a carcinogen is often necessary. For example, many workers who were exposed to asbestos for a prolonged period developed a particular form of lung cancer called mesothelioma. It takes at least 20 years – and in many cases 40 years – before the cancer appears. Since asbestos is no longer used in the construction industry, no new cases of occupational mesothelioma are expected to occur in the United States after 2042.3

5. **Carcinogens pose a lifelong risk.**

Carcinogens do not cause cancer in every case. Substances labeled as carcinogens may have different levels of cancer-causing potential. It is true that a large amount of a cancer-causing substance leads to cancer much more frequently. But even very small doses can develop a harmful effect – although the probability is clearly lower.

The risk of developing cancer due to contact with a carcinogen remains throughout one’s lifetime, since in many cases cell damage does not develop until years after contact with the substance. And for any particular person, the risk of developing cancer depends on many factors – including how they are exposed to a carcinogen, the length and intensity of the exposure, and the person’s genetic makeup.

6. **Occupational cancer is more common than previously thought.**

- Approximately 3 to 6% of all cancer cases are due to substances in the workplace4,5
- Europe: More than 100,000 deaths every year are due to job-related cancer6
- USA: Each year, there are as many as 90,000 new cases of cancer and 30,000 work-related deaths globally7

7. **A mouse is not a human, and vice versa.**

Detecting the cancer-generating property of a chemical agent is often very difficult. It is not ethical to test a substance by exposing people to it and seeing if they get cancer. That’s why scientists must use other types of tests – which may not always give clear answers. For example, it is not easy to deduce whether or not a substance is carcinogenic from animal testing.

Rodents and humans often react to chemical substances in entirely different ways. 19 out of 20 test substances that are considered safe for humans cause cancer in rodents.8 However, of 19 substances known to cause cancer in humans, only seven prove to be carcinogenic in rodents.9 Here’s another example: The artificial sweetener saccharine gives rise to bladder cancer in male rats, but not in female rats – or humans.10

This is why multiple sources should be used and combined, such as:
- Lab studies in animals and examinations
- Tests and lab studies of human cell cultures
- Human case and epidemiologic studies and observations from practice
The chemical industry is subject to a particularly high risk.
From benzene to formaldehyde and acid aerosols: Carcinogenic substances are found in many areas of the chemical industry. The protection of employees from carcinogens is therefore one of the central challenges for occupational health and safety.

When is a substance labeled as carcinogenic?
When the evidence is conclusive, the substance is labeled as a carcinogen. When the available evidence is compelling but not felt to be conclusive, the substance may be considered to be a probable carcinogen. But in some cases, there simply isn’t enough information to be certain one way or the other.


Most people know that asbestos is a potential cancer threat in the workplace. But what about trichloroethylene, benzene, or the various chromium compounds? The European Trade Institute has listed 71 cancer-causing substances that constitute 80% of the carcinogens to which people may be exposed in the workplace. Binding occupational exposure limits are being mandated for at least 50 substances that cause work-related cancer. Various organizations test chemicals for their cancer-causing potential. Chemicals, mixtures, substance groups, and other carcinogens are divided into different groups, as follows:

### IARC*

<table>
<thead>
<tr>
<th>Group 1:</th>
<th>Carcinogenic to humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2A:</td>
<td>Probably carcinogenic to humans</td>
</tr>
<tr>
<td>Group 2B:</td>
<td>Possibly carcinogenic to humans</td>
</tr>
<tr>
<td>Group 3:</td>
<td>Not classifiable with regard to carcinogenicity to humans</td>
</tr>
<tr>
<td>Group 4:</td>
<td>Probably not carcinogenic to humans</td>
</tr>
</tbody>
</table>

*International Agency for Research on Cancer (IARC)/Division of the World Health Organization (WHO)

10. More knowledge leads to more safety.

All types of occupational cancer are preventable. To minimize the risk of cancer caused by on-the-job exposure, substances considered to be carcinogenic should not be used at all. But that is not always possible. However, taking appropriate measures can significantly reduce the health danger to workers. Strong regulatory control – including occupational exposure limits, worker education, and constant attention to safe practices – are needed to minimize workplace exposure to carcinogens.

Binding occupational exposure limits are only one aspect of better health and safety at work - hazardous substances can still pose a health hazard. In addition to the minimization of exposure, appropriate protective and safety equipment is therefore important. In addition, all employees dealing with carcinogenic substances should be trained and treated with medical care.

### Occupational cancer has been known since 1755

- **1755:** Recognition of testicular cancer in chimney sweeps as an occupational cancer
- **1895:** Identification of 2-naphthylamine as cause of bladder cancer in dye plant workers
- **1974:** Recognition of vinyl chloride as the cause of liver tumors in the plastics industry
- **2011:** Classification of formaldehyde as carcinogenic


For an extensive list of potentially carcinogenic substances that includes IARC, ACGIH and OSHA classifications, go to: https://www.ehs.uci.edu/programs/sop_library/CARCIN.pdf