CHEMICAL HAZARDS

Norway grants

RCB
Rządowe Centrum Bezpieczeństwa

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1. What is a chemical hazard?

A chemical hazard is a release of chemical elements and compounds, mixtures or solutions which are hazardous to people and the environment, occurring naturally in the environment or resulting from human activity.

2. What are chemical agents?

Chemical agents are chemical substances or preparations which have an effect on people and the environment.

Due to their properties, their effects may be:

- toxic
- irritant
- allergenic
- carcinogenic
- mutagenic

What does it mean if a chemical agent is toxic?

Toxicity means that a chemical substance or preparation has the potential to cause damage to the living organism resulting in poisoning or impairment of the function of cells, organs or the entire organism.

Toxicity is influenced by:

- physicochemical (extrinsic) properties, e.g. solubility of the substance in water and fats, which determines penetration through the cell membrane; boiling point and evaporation temperature; particle size - smaller particles have stronger toxic effect because they are absorbed more quickly into the blood in the lung alveoli; chemical structure and structure of the molecule

- biological factors (intrabody), i.e. the properties of the living organism, such as age and individual development - children and the elderly suffer from stronger toxic effect; gender - women are more prone to the effect of pesticides and psychotropic drugs than men; genetic factors - e.g. genetically determined metabolic diseases; environmental factors - atmospheric pressure, temperature, ionising radiation

What does it mean if a chemical agent is irritating?

The irritant effect results from direct contact of the chemical with the eyes, skin and respiratory tract. Substances that irritate the eyes include acids, alkalis (bases) and solvents, the skin - alkalis, acids, organic solvents, soaps and washing agents. The respiratory tract is irritated by gases, dusts or chemical vapours.

Eye irritation may result in, for example, tears, or even permanent damage. During direct contact with the skin, some chemicals may damage the skin's protective layer, causing it to become dry, rough and ulcerated. Such a condition is referred to as irritant or toxic eczema.

The irritant effect of gases, dust or chemical vapours results in inflammatory changes in the airways.

These reactions affect various parts of the respiratory tract and may be of variable intensity. Gases and vapours of substances such as hydrogen fluoride, hydrogen chloride, ammonia, formaldehyde and acetic acid cause changes in the upper respiratory tract. Chlorine, sulphur dioxide, arsenic trichloride, phosphorus trichloride cause changes in the upper respiratory tract and bronchi. Irritation leads to coughing and sneezing. Phosgene or nitrogen oxides cause changes directly in the lung tissue, which can lead to pulmonary oedema and the occurrence of alveolar effusion. It is important to remember that substances that affect the respiratory system also damage its defence mechanisms. This leads to a significantly lowered function of the immune system and an increased susceptibility to infections, asthma and may even cause pulmonary emphysema.

What does it mean if a chemical agent is allergenic?

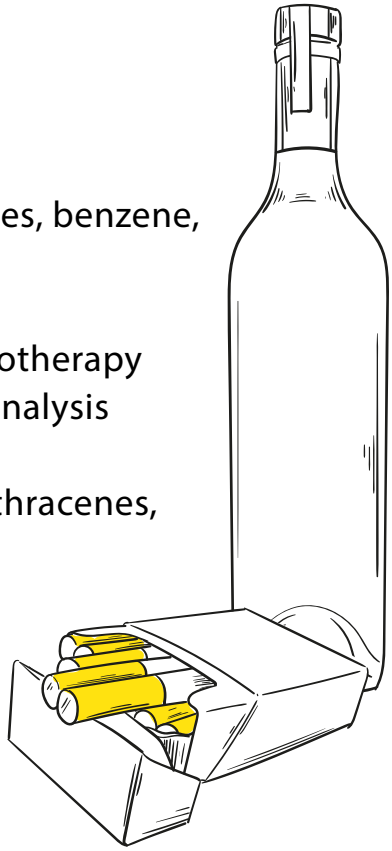
Allergy is the body's immune response to stimulation by an allergen. It leads to an increase in serum histamine, which causes a drop in blood pressure. This is accompanied by heart rate acceleration and an increase in body temperature. In addition, there are contractions of smooth muscles of the bronchi and gastrointestinal tract and swelling. An allergic reaction can lead to coma and even death.

What does it mean if a chemical agent is carcinogenic?

A carcinogen, also known as a carcinogenic agent, is an external agent which causes changes in the genetic material of a cell, leading to the development of cancer.

Examples of chemicals which are carcinogens:

- asbestos - material used in construction
- organic chemicals used in industry: aromatic amines, benzene, vinyl chloride, dioxins
- alcohol
- alkylating agents - cytostatic agents used in chemotherapy
- thorotrast - substance used as a contrast in X-ray analysis
- free radicals
- tarry substances contained in cigarette smoke: anthracenes, benzopyrene, aromatic amines, nitrosamines
- aflatoxin - a toxin produced by moulds
- heavy metals: arsenic, nickel, lead



What does it mean if a chemical agent is mutagenic?

Mutagenic chemical agents affect a cell of a living organism, causing mutations in the genetic material of the cell, which in turn leads to a disruption in the structure of the cell. As a result, their structure is abnormally reconstructed when they divide or when they produce new building blocks - proteins. This leads to neoplastic changes, birth defects or the transmission of new characteristics to offspring.

Chemical mutagens are, for example: aromatic hydrocarbons (e.g. benzene) or pesticides, including the once widely used DDT, alkaloids, benzopyrene or unstable oxygen compounds.

Non-permanent oxygen compounds cause oxidation and rearrangement of other compounds, including DNA. They are very active agents, also known as oxidants or free radicals. Their excess, resulting from exposure to harmful chemicals, can lead to numerous mutations. A way to reduce the harmfulness of oxidants is to provide the body with antioxidants, which bind free radicals in neutral compounds, thus neutralising them.

Antioxidants include vitamin A, vitamin C, vitamin E, beta carotene, lycopene, lutein, selenium, manganese.

Prolonged contact with a chemical agent causes occupational diseases.

Chemical substances can penetrate the body through:

respiratory tract

skin

digestive tract

3. Hazardous chemical substances

Hazardous chemicals are found in virtually every area of life in the modern world, from household products, such as chlorine-based detergents and pipe cleaners, to those used in industry. Virtually every major industrial facility, especially those in the chemical, pyrotechnic, energy, pharmaceutical, processing, metallurgical, pulp and paper industries, can pose a risk because of the hazardous substances used in their technological processes.

It is therefore important to know what to do in the event of contact, burns or poisoning with a chemical. It is also a good idea to find out whether the factories in the area where you live (if there are any) use chemicals in their production processes, and if so, which ones, so that you know what to do in the event of an accident.

In the case of chemicals used in the household, always follow the manufacturer's instructions and keep them in sealed containers away from children. Failure to observe these seemingly basic rules can lead to permanent health impairment.

4. Chemical burns

Chemical burns are understood to be the direct effect of corrosive substances (acids and alkalis) on the skin and mucous membranes or of toxic vapours on the respiratory tract.

The symptoms of chemical burns, as well as their intensity and extent, depend on the chemical agent with which the victim came into contact, its quantity, time of contact between the substance and the skin, the concentration, the type of substance (liquid, gas, solid), the location of the burn, etc.

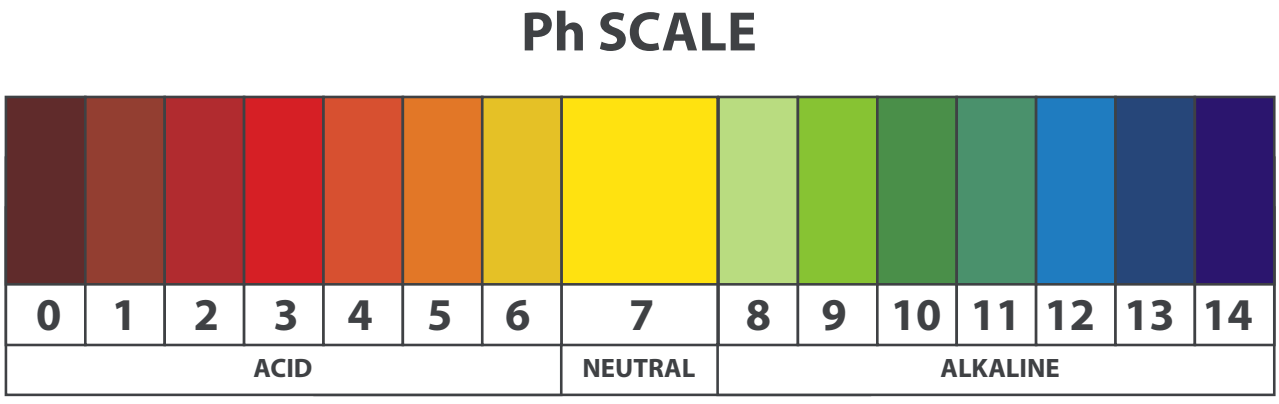
Chemical burns are most common in industries where acids are commonly used, e.g. textiles, paints, fertilisers, refineries and pharmaceutical plants. Burns are also common in the domestic environment due to the improper use of detergents - remember, all patients with chemical burns should be treated in hospital.

Acid burns

An acid burn causes damage of varying depths to the skin and mucous membranes. There is usually reddening and irritation of the skin. Wounds and blisters form. Acid burns manifest themselves as hard, dry scabs (dry necrosis). In the case of hydrochloric acid, the scabs are white, while sulphuric acid causes black scabs. Hydrogen fluoride (fluorane) is particularly dangerous, because in small doses it does not cause any pain or skin changes, but it penetrates very easily through the skin into deeper organs (e.g. bones) and damages them.

Alkali burns

Alkali burns cause liquefactive necrosis on the skin (enzymatic digestion of cells and tissues turns the dead tissue into a solid mass). These types of burns damage the skin profoundly (including the respiratory tract) and, due to the liquefactive necrosis, it is difficult to clearly define the boundaries of the injury.
As with acid burns, scabs are formed. However, they are white, soft and moist.



5. Procedure in case of chemical burns

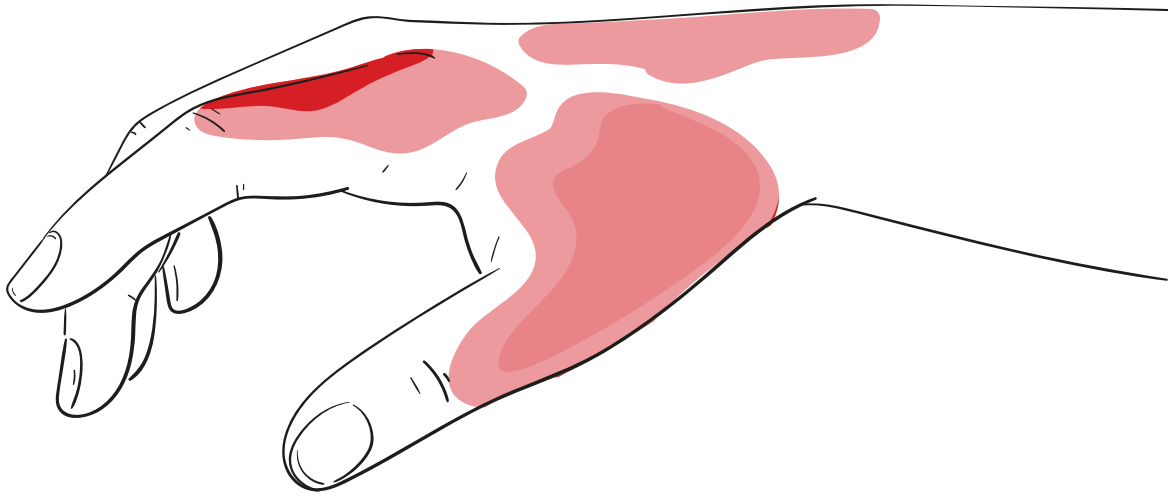
The first step is to remove the chemical substance from the skin as quickly as possible. If this can be done within 2 minutes, the effect on the skin will be less severe. Rinse the area of contact with the chemical under a current of water for a dozen of minutes.

- For quicklime burns, first wipe the substance off the skin with a dry cloth and then rinse the burned area with a strong jet of water.

- In the case of acid burns, the skin is washed with alkaline liquids, e.g. soap solution, 3% saline solution, limewater.

- In the case of lye burns, the skin is rinsed with acid solutions, e.g. 1% citric acid, 1% acetic acid, 3% boric acid.

After rinsing is completed, the burned area should be protected with a dry, sterile dressing. Contact a physician as soon as possible.

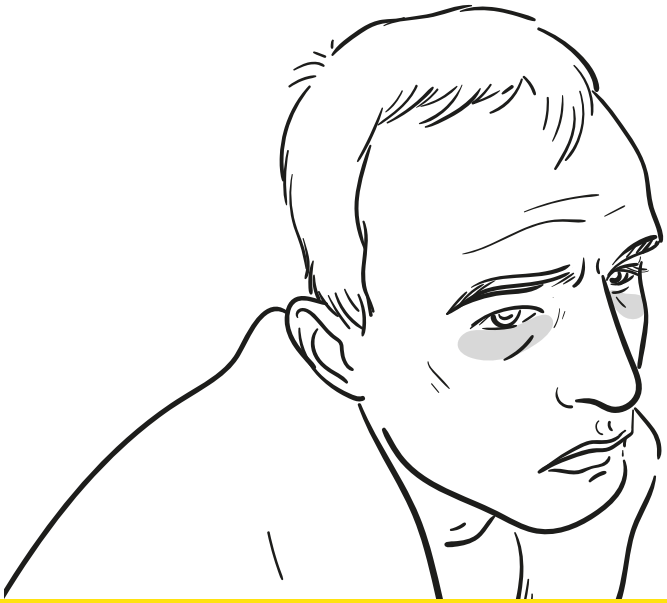


6. Procedure in case of ingestion of a chemical agent

Symptoms which can occur as a result of swallowing a chemical agent are:

- cough
- headache
- dizziness
- heart rhythm disturbances
- weakness
- muscle twitching
- low blood pressure

If a chemical is swallowed, call for medical help as soon as possible (if the patient is unconscious) or go to the nearest hospital.



ATTENTION

Do not give anything to eat or drink to the person who has swallowed chemical substance!

7. Handling hazardous chemicals in the form of gas

IMPORTANT!

The odour of chemicals/chemical substances is generally perceptible well before their concentration reaches a life-threatening level. However, you should also bear in mind that there are odourless substances, such as carbon monoxide, which is a poisonous gas.

REMEMBER!

If you hear a warning signal or a message about a chemical hazard

REACT IMMEDIATELY!

If you are in a car:

- close the windows
- turn off the air conditioning and ventilation
- leave the contaminated zone as quickly as possible
- listen to the local radio

If you are outside the building:

- get into the nearest building as soon as possible
- if possible, move perpendicular to the direction of the wind
- protect your airways as much as possible, e.g. by breathing through a handkerchief, clothing or other material
- leave your outer clothing and shoes outside the building

If you are in a building (inside a building, toxic fumes have lower concentration):

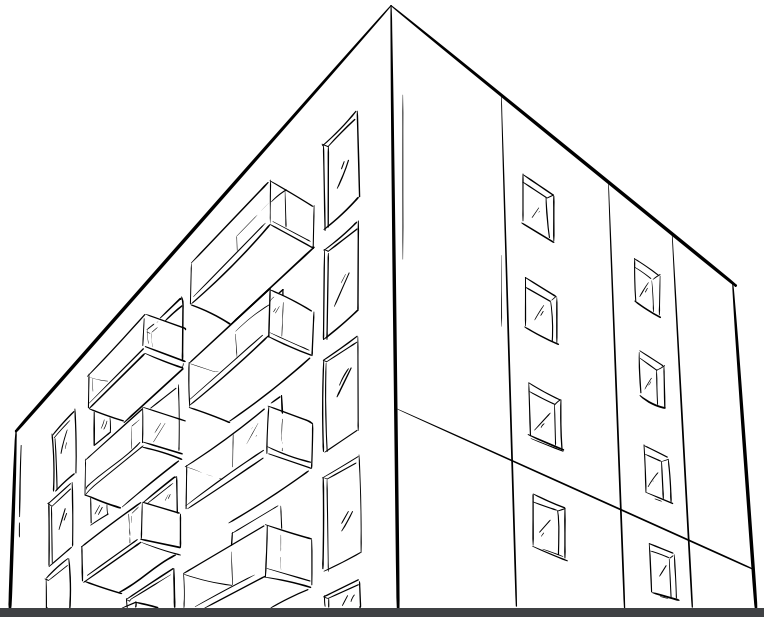
- close all windows and doors
- turn off ventilation and air conditioning
- listen to the local radio or TV all the time
- seal all openings around doors and windows
- close all doors to ovens, and fireplaces
- seal all openings and ducts
- if you have come into contact with hazardous substances:
    - do not touch your mouth or eyes
    - wash yourself in the shower or, if this is not possible, wash your hands and face under running water
- if you suspect that gas or noxious fumes are getting inside, breathe shal lowly through damp clothing or other material

When the competent services arrive, always follow the instructions of the rescue team leader!

If you are in an immediate danger zone during a chemical incident:

Outside the building:

- avoid contact with any suspect substances or objects
- do not touch or smell them
- protect your airways by breathing shallowly through clothing or other material
- try to leave the danger zone as quickly as possible



Inside the building:

- avoid contact with any suspect substances or objects
- do not touch or smell them
- close the windows
- switch off fans and air conditioning
- leave the room and close the door behind you
- protect your airways by breathing shallowly through clothing or a towel
- try to leave the danger zone as quickly as possible

8. Characteristics of selected chemicals

Hydrochloric acid (muriatic acid, HCl)

Pure hydrochloric acid is colourless. The occasionally found yellowish colour of technical hydrochloric acid is due to contamination with iron ions. It is one of the strongest inorganic acids. It has no oxidising properties and is volatile, which makes it less toxic than strong oxyacids (e.g. nitric, perchloric or sulphuric acid).

The smell is slightly asphyxiating at concentrations of around 9%, while at concentrations of 28% hydrochloric acid is pungent and asphyxiating.

Concentrated hydrochloric acid releases hydrogen chloride gas, which in turn reacts with the moisture in the air to form a mist. For this reason, concentrated hydrochloric acid is described as "smoky". Hydrochloric acid with a concentration of less than 30% is no longer smoky.

Sulphuric acid (VI) (H_2SO_4)

Anhydrous sulphuric acid is a thick, oily liquid which is thinner than water. It is a strong, highly corrosive acid. It is one of the strongest-acting mineral acids. Sulphuric acid dissolves extremely well in water in all proportions, giving off a considerable amount of heat. For this reason, when diluting it, it is essential to make sure that the acid is poured into water and not vice versa.

Concentrated sulphuric acid is a strongly oxidising acid. When heated to approx. 100 °C, it reacts with copper and silver, giving off sulphur dioxide (under normal conditions it is a colourless gas with a pungent and asphyxiating smell, highly irritating to the respiratory tract).

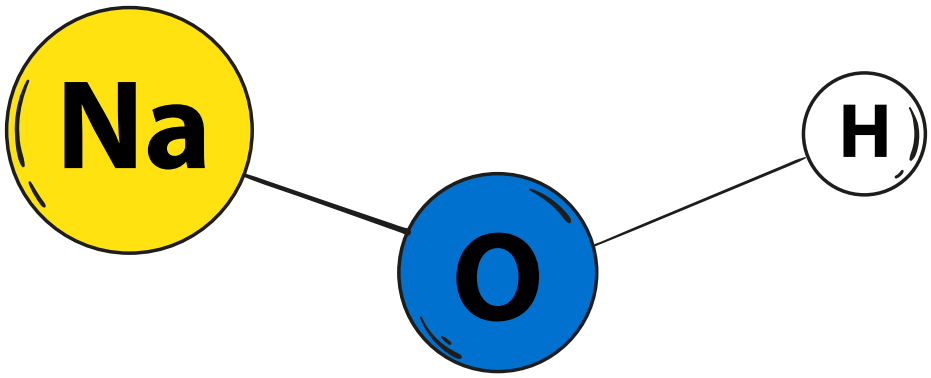
Sulphuric acid destroys the protein structure and carbonises most organic compounds containing oxygen.

Nitric acid (HNO3)

Nitric acid is a colourless liquid with an extremely pungent odour and corrosive properties. In prolonged storage, it turns yellow when exposed to temperature, as a result of spontaneous decomposition into nitrogen oxides and water. It reacts readily with many substances, and when dissolved in water produces heat. A significant proportion of reactions involving it are downright explosive.
Concentrated nitric acid is a very dangerous substance. In contact with skin, it causes severe burns and even necrosis. In vapour form, it attacks the respiratory tract, leading to swelling and inflammation of the lungs. Accidental ingestion can cause death due to perforation of the stomach or intestinal wall.

Sodium hydroxide (NaOH) caustic soda

Sodium hydroxide solution is one of the strongest bases. It is a crystalline, white substance that dissolves in water to form corrosive caustic soda lye. Caustic soda has strong hygroscopic properties, it is corrosive. It emits no odour and has no taste.



Potassium hydroxide (KOH)

Potassium hydroxide, like caustic soda, is one of the strongest bases. It is a white solid with very high hygroscopicity. It dissolves well in water to form a strongly alkaline potassium lye.

Lithium hydroxide (LiOH)

Lithium hydroxide is a colourless or white solid. It has hygroscopic properties. It is toxic. It causes a change in the structure of proteins by breaking the hydrogen bonds, known as denaturation.

Calcium hydroxide (Ca(OH)2)

The aqueous solution of calcium hydroxide is limewater, which is a strong alkali with a corrosive effect (lime water is used, among other things, for the detection of carbon dioxide).

Barium hydroxide (Ba(OH)2)

Barium hydroxide is a strong, corrosive substance in the form of white granules or powder.

9. Chemical agents that can be used as chemical weapons

Causing burns:

- Sulphur mustard (HD), Nitrogen mustard (HN), Lewisite (L), mustard/Lewisite mixtures (HL), Oxygen mustard (T), Phosgene oxime (CX), Ethyldichloroarsine (ED), Methyldichloroarsine (MD)

Haemoglobin blockers:

- Arsenic hydrogen (S.A), Cyanogen chloride (CK), Hydrogen chloride, Hydrogen cyanide (AC)

Damaging Respiratory system:

- Chlorine (Cl), Diphosgene (DP), Phosgene (CG), Nitric oxide (NO), Perfluoroisobutene (PFIB, Pl. PHIB), Red phosphorus, Zinc oxide (HC)

Psychotoxic:

- LSD, Cannabinoids (hashish, marijuana), Fentanyls, Phenothiazines

Nerve agents in the form of gas:

- Sarin (GB), Soman (GD), Tabun (GA), VE, VG, V-gases, VM, VX

Irritant agents:

- Chloroacetophenone (CN), Chloropicrin (PS), CS, CNS, CNC, CR, Bromobenzyl cyanide (BBC)

Emetic agents:

- Adamsite, Diphenylchloroarsine (DA), Diphenylcyanoarsine (DC)

10. Means of declaring and cancelling a contamination alert

Announcement of alert

Acoustic signal:

Intermittent, modulated siren sound

A sequence of short signals, given by the sound of a vehicle or other similar device or by hitting a metal or other object in a 1:1 ratio, approximately 1 second sound and 1 second pause.

In mass media:

Verbal announcement repeated three times:

ATTENTION! ATTENTION!
I am declaring a contamination alert ..... (state type of contamination) for .....

Visual alert signal:

Black sign, preferably in the shape of a triangle.

Alarm cancellation

Sound signal:

Continuous sound lasting 3 minutes.

In the mass media:

Verbal announcement repeated three times:

ATTENTION!! ATTENTION!!
I cancel the contamination alert for.....

11. Emergency phone numbers

In Poland the emergency number is **112**

The introduction of the emergency number did not exclude other emergency numbers for emergency services, which are also in operation:

- **997** – Police
- **998** – National Fire Service
- **999** – National Medical Emergency Service

12. Examples of emergencies including accidents/failures involving chemicals or their deliberate use

Flixborough, UK, 1 June 1974

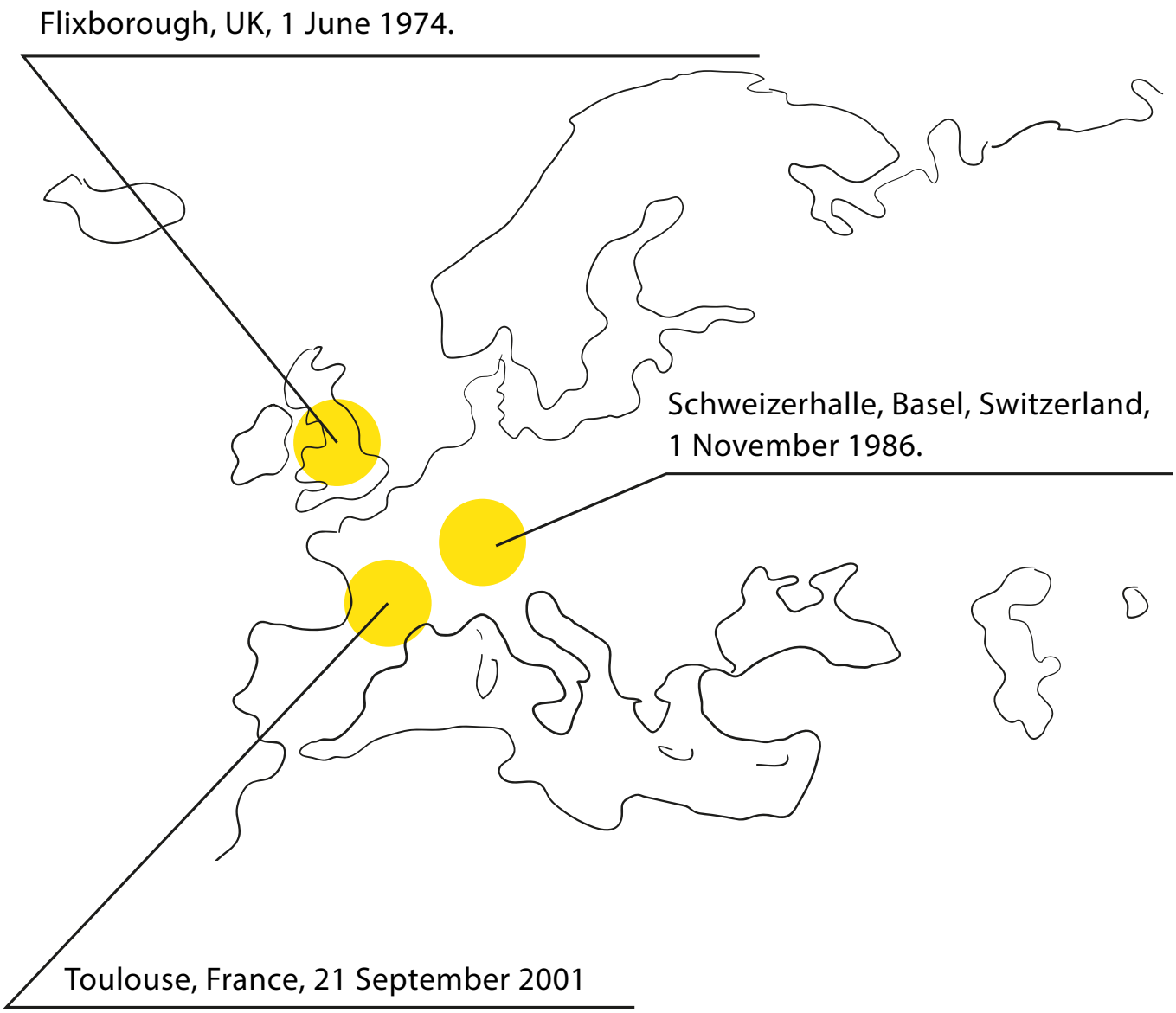
The failure occurred at the Nypro Ltd chemical plant, Flixborough (near Scunthorpe), which mainly produced raw material for the manufacture of nylon. Around 80t of hot (155°C) liquid cyclohexane, at a pressure of 8 bar, was released from a ruptured 20-inch pipeline. The resulting mixture of cyclohexane vapour and air caused an explosion equivalent in force to that of 30 t of TNT. The disaster killed 28 plant workers, 36 workers were injured, several hundred people outside the plant were affected in various ways, 53 of whom suffered serious injuries. The plant was completely destroyed (within a radius of about 5 km) and there was also significant damage outside the plant.

Schweizerhalle, Basel, Switzerland, 1 November 1986

A fire broke out in Sandoz's warehouses, which contained around 680 tonnes of pesticides. Water used for extinguishing the fire got contaminated with pesticides based on mercury and zinc, as well as organophosphorus insecticides (dichlorvos, disulfoton, parathion and others), and flowed into the Rhine through a drainage system. The mass of substances that entered the Rhine ranged from 5 to about 20 tonnes. The consequences of this accident were catastrophic - biological life in the Rhine was destroyed along about 400 km of the river, water intakes for water supply in Germany and the Netherlands were closed, and tourism and economic activities on the French bank of the river were completely closed.

Toulouse, France, 21 September 2001

At the AZF plant of Grande Paroisse, a series of explosions occurred at the ammonium nitrate storage facility, where about 400 t of this product was located. The number of fatalities reached 30, including 8 outside the plant. Approx. 2,500 people were injured, 30 of them very seriously. The force of the explosion was 20 - 40 tonnes of TNT.



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