



## CLEANING AND RECYCLING OF GASEOUS WASTE.

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<https://doi.org/10.5281/zenodo.7466197>

Annotation: Absorption by means of liquids is based on the property of selective dissolution of harmful compounds in various solvents, and it is currently the most common and reliable method.

Keywords: chemical industry, enterprises, chemicals, acids, alkalis, salts, mineral fertilizers, polymers, synthetic fibers and other types of products.

Various cleaning methods are used in order to ensure that the toxic gases emitted by industrial enterprises are in the normal amount possible. These methods are selected depending on the content of toxic gases emitted by industrial enterprises.

Mists in industrial waste gases mainly consist of sulfuric and phosphoric acids. In the second group, there are quite a few additives in the form of gas and vapor, which mainly include acids, colloids and colloid derivatives, as well as oxides in the gas state, aldehydes, ketones, alcohols, hydrocarbons, amines, pyridines. In addition to the harmful compounds contained in industrial exhaust gases, which are harmful to humans, plants and animals, these wastes also cause economic damage.

Depending on the composition of toxic chemical gases emitted by industrial enterprises, they can be of several types. Harmful additives in industrial waste gases are divided into two groups:

- ☑ small particles (aerosols), dust, smoke and fog;
- ☑ gas and vapor compounds;

The first group consists of solid and liquid particles of organic or inorganic nature, which are released into the air together with gases and emissions from the ventilation system. Inorganic dust is formed during the processing of metal and its ores, aluminosilicates, various mineral salts, fertilizers, carbides and similar inorganic compounds in industrial waste. Dusts with organic characteristics include coal, peat, slanes, pistachio coal and soot.

Because together with these waste gases, many useful compounds that cannot be collected, organic solvents, metals, and sulfur oxides are released into the air. For example, the amount of sulfur emitted into the air in economically developed countries is greater than the amount of sulfur needed for the production of sulfuric acid in this country. In addition, when there are various chemicals in the air, metals rust quickly, for example, steel in industrial areas rusts 3-4 times faster than in rural areas.

Important measures to protect atmospheric air from harmful industrial wastes are to prevent harmful compounds by rational organization of new production processes and improvement of existing ones, or by using cyclical schemes in individual processes and comprehensive use of raw materials and waste, consists of organizing new productions.

For example, if SO<sub>2</sub> emitted from non-ferrous metallurgy plants is used to obtain sulfuric acid, the air will be protected from pollution, and at the same time, the cost of sulfuric acid

produced will be reduced by 30% compared to sulfuric acid produced by other methods in chemical plants.

An example of a cyclic process that does not emit gases into the atmosphere is the synthesis of ammonia. In the current state of technique and technology, there are almost no opportunities to avoid releasing toxic compounds into the air. Therefore, the easiest way to protect the air from such compounds is to use various gas cleaning facilities. The main task of such facilities is to reduce the concentration of toxic compounds in waste gases to a concentration that is permissible according to sanitary standards.

It is impossible to do this work with the help of gas purifiers, in which case the concentration of harmful compounds in exhaust gases is reduced several times by diluting them several times or they are released into the upper layers of the atmosphere through very high gas pipes.

Depending on the description of harmful compounds in waste gas, their cleaning methods are divided into three types:

- ☒ absorption using liquids;
- ☒ adsorption using solid absorbers;
- ☒ catalytic cleaning;

Absorption using liquids is based on the property of selective dissolution of harmful compounds in various solvents, and it is currently the most common and most reliable method.

This method is used to capture carbon oxides, nitrogen oxides, chlorine, sulfur (II) oxide, hydrogen sulfide and other sulfur compounds, acid vapors, cyanide compounds and various toxic compounds (phenol, formaldehyde, fluorine dioxide) from waste gases on an industrial scale. is widely used.

The adsorption cleaning method consists of a continuous cyclic process, because the liquids used in this method are regenerated after a certain time and used for cleaning again. Towers filled with fillers, plate or shelf reactors are more commonly used as absorption reactors in industry. The peculiarity of this method is its continuity, relatively low cost, retention of many harmful compounds, and easy regeneration of cleaning fluids. Its disadvantage is the large number and roughness of the equipment used, the complexity and multi-stage technological processes.

It is based on absorption of harmful compounds in waste gas by adsorbents. Adsorbents consist of granular solid material with a very large surface area. Activated carbon silica gel and synthetic cellulites are often used as such adsorbents. Such adsorbents are highly absorbent, thermally stable, easily regenerated and work for a long time without changing their structure and surface.

Gases are mainly adsorbed in batch reactors. Adsorbents are placed on these racks, and a flow of purified gas is supplied from the upper part of the reactor at a speed of 0.05-0.03.

After a certain time, the adsorbent becomes saturated and loses its activity. In this case, the process is stopped and regenerated by heating the adsorbent, giving supersaturated steam, blowing with air or inert gas. The main disadvantage of the adsorption method is its operation in a periodic process and the high cost of the adsorbents used in this method. That's why a lot of work is being done on the introduction of continuously working adsorption methods.



Catalytic cleaning of gases is based on catalytic reactions, in which all harmful compounds in the gas are replaced by other harmless compounds. For these purposes, solid-state heterogeneous catalysts are used, and purification is carried out at a high level.

A specific disadvantage of the catalytic cleaning method is that additional cleaning steps are needed to remove new compounds formed during cleaning, which reduces the economic efficiency of the method to a certain extent. In general, all the methods considered above require a lot of money. The higher the level of purification, the more and more complex the equipment used in the methods.

For example, in order to reduce the amount of nitrogen oxides formed in the production of nitric acid from 0.25 to 0.05% of aqueous adsorption, or to increase the adsorption to 99.5%, it is necessary to double the height of the absorbers used.

The possible concentration of NO in the air is 0.1, so it is possible to use the most effective methods to reduce it to this concentration, that is, to use a catalytic method that reduces the concentration of nitrogen oxides to 0.0001%.

This is a concentration that can be allowed by sanitary standards of 0.001 volume. However, the use of the catalytic cleaning method increases the cost of the produced HNO<sub>3</sub> by 10-12%.

In order to compare the above-mentioned methods and their technical and economic indicators, we will consider the process of extracting H<sub>2</sub>S from a gas mixture.

We use absorption and adsorption and catalytic methods to extract this poisonous H<sub>2</sub>S. Ethanolamine solutions, soda solution of arsenic, carbonates of alkali metals, ammonia, calcium hydroxide suspension and similar reagents are used as cleaners in the absorption method. Even with the use of all reagents, H<sub>2</sub>S passes into this solution. So that the formed absorbent solution does not poison the water bodies, this solution is regenerated. All absorption scrubbers operate at low temperatures or high pressures.

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