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Analysis of organic solvents released during painting and drying of automobiles and household products

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The article presents the results of a study of the drying process of paints and varnishes based on organic solvents. and environmental problems. An analysis of the current scale of their use is carried out and an assessment is made of environmental problems associated with their evaporation. The issues of organizing the collection of the resulting solvent vapors and their further use, taking into account their use in specially equipped rooms, are considered.

Places where attention should be paid to the observance of precautionary measures in enterprises are warehouses where stocks of dyes and other chemical reagents are stored, stations for the preparation of feed and working solutions of dyes and various auxiliary substances. Organic dyes are flammable. Dust and dust-air mixtures of most of them are flammable and explosive. Paints related to nitro compounds are explosive. Diazo compounds, including diazoles, are highly explosive, especially at high temperatures. Therefore, these products should be stored and handled in conditions that exclude their overheating. The inclusion of inert additives in the final forms of paints reduces the risk of explosion and fire of settled dust and dust-air mixtures. Significant improvement of sanitary working conditions, reduction of dust emission is supported by the use of paints in special final forms – dust-free powders, granules, liquid form. Work rooms where paints are stored and work with them, related to the formation of dust, must have a strong supply and exhaust ventilation. It is necessary to constantly monitor the level of dust in these buildings. Electrical equipment must be assembled in an explosion-proof design. The preparation of concentrated and working solutions of paints should be carried out in closed equipment, if necessary, it should be equipped with local exhaust ventilation. Remember that many paints are toxic. Most of them irritate the skin and mucous membranes [1]. In particular, arylmethane-

based and acidic paints can cause otitis, laryngitis, and digestive tract diseases. Reactive dyes should be considered as potentially hazardous substances. These dyes are able to react chemically with protein substances that can cause various diseases. It is necessary to exclude dyes and other chemical reagents from falling on the body and clothes of workers (use of overalls, glasses, gloves), as well as accumulation of dust and dirt in production buildings. The preparation of dyeing and development solutions involves the use of various chemicals – acids, alkalis, oxidizing agents, reducing agents, organic solvents, etc., which themselves can have a harmful effect on the human body. Thus, concentrated acids (sulfur, vinegar), alkalis irritate the mucous membranes, causing severe burns if they come into contact with the skin. Acetic acid is a flammable liquid. Hydrogen peroxide solutions should be stored in glass, aluminum or polyethylene containers at a temperature not higher than 30 °C. The possibility of contact of H_2O solutions with flammable substances, with organic solvents that can form explosive mixtures with H_20 2 should be excluded. Hydrogen peroxide solutions cause burns if they come into contact with the skin. Sodium dithionite can cause irritation of mucous membranes; sodium sulfide – toxic, skin irritant, flammable, its dust is explosive. Sodium nitrite is very toxic, and when working with it, it is necessary to completely exclude the possibility of its getting into the digestive system. Solutions of dyes and auxiliary substances used directly in technological processes in the main shops (dyeing, printing), as a rule, do not pose a threat to the health of workers due to the relatively low concentration of dyes and other chemical reagents in them. However, in some cases, dyeing processes can produce substances harmful to the human body. Thus, with the nitrite method of cupping, it is possible to release nitrogen oxides that affect the respiratory tract and have a harmful effect on the central nervous system. Special precautions should be taken when working with organic solvents. They can have a general toxic effect on the human body, cause acute and chronic poisoning, skin and mucous membrane irritation. Some organic solvents are flammable [2].

Care must be taken to control their content in work environments that must have effective supply and exhaust ventilation. When organic solvents are used in painting processes, it is necessary to create closed technological cycles with solvent capture, recovery and reuse. This ensures not only good sanitary and hygienic conditions, but also high efficiency of the process, protection of the environment from harmful waste, saving water consumption for technological needs, and a significant reduction in the amount of wastewater. In this regard, the development of a line of paints for painting with non-aqueous media and equipment for its implementation is a very urgent task. In the main workshops of finishing production, it should be remembered that the textile materials themselves (fibers, fabrics, knitted fabrics) are fire hazard. Many of them (lavsan, nitron, nylon, ace-

tate fibers) release toxic products when burned. To create normal working conditions, all workshops of textile industry finishing enterprises should be equipped with strong supply and suction ventilation. Compliance with the above precautions in the use of coloring substances is mandatory in other areas. Thus, in particular, it should be taken into account that the components for oxidative dyeing of fur are mostly toxic and irritate the skin and mucous membranes. Oil-soluble dyes, sometimes used in painting plastic, rubber, are quickly absorbed into the skin and cause skin diseases. In the paint and printing industry, a large amount of flammable and toxic organic solvents and film-forming substances are used. In accordance with national requirements, all enterprises that use paints must develop a system of socio-economic, organizational, hygienic and sanitary-technical measures and tools to prevent workers from being exposed to harmful production factors [1].

In machine-building plants, painting is carried out in paint shops and machine assembly shops.

By the development of modern technologies, we certainly understand things like the mechanization of the application of paint and varnish material. At the same time, compared to brushing, labor productivity and material consumption are significantly increased, and as a result, volatile components are released into the air. Contains less or no solvents, which leads to the development of new methods for applying more viscous paints that lead to improved working conditions. Pneumatic painting is currently one of the most widely used processes in mechanical engineering. The method consists in crushing the paint material with compressed air and applying it to surfaces for painting in the form of a fine dispersed mass. In this case, paints form a fog cloud, which pollutes the air of the workplace.

In airless spraying devices, paint materials are fed to the nozzle under a pressure of 40–60 atm; in a number of devices, in addition, the material is heated to 50–80 °C. This allows for the use of more adhesive materials compared to pneumatic spraying and, as a result, contains less solvent. An important component of many coatings are organic solvents. As a rule, inorganic compounds are used as pigments: oxides, salts of heavy metals. Application of coatings in spray booths produces solid, pasty and liquid waste, solvent vapors and water saturated with solvents and colored aerosols. The greatest danger to the human body is volatile organic compounds (solvents) released into the atmosphere during the application and drying of paints; heavy metals in the aerosol formed during the application of paint materials; isocyanates, phthalic and maleic anhydrides, formaldehyde, fatty acids and other compounds released during drying of paint materials (especially at high temperatures) [2]. At the same time, it should be noted that solvents are designed to provide technological parameters for obtaining paint and varnish coating and are completely absent in the resulting coating. Taking into account the global consumption of coatings, the total emission of organic solvents into the

atmosphere reaches 12–18 million tons per year. Volatile organic compounds (ketones, alcohols, ethers) cause various allergic reactions and poisoning, while styrene, chlorobenzene and ethylbenzene are carcinogenic. Various methods are used to clean gaseous waste: oxidation with oxygen in catalysts, direct burning of harmful compounds, capture using hydrofilters, as well as sorption methods that allow separating substances for reuse in production. Reducing the emission of harmful substances into the atmosphere can be achieved using engineering solutions:

– optimization of painting process;

– automation of equipment;

– modernization of circulation systems;

– waste processing;

– introduction of coatings with high dry residue, water-resistant, dust- and radiation-strengthened;

– use of coatings with a content of non-volatile substances from 65 % to 75 %, reducing the consumption of organic solvents by 30 %; allows to reduce the consumption of coatings and increase the service life of coatings by 1,5–2 times.

When working with a torch device, 8–18 % volatile substances and 1–7 % aerosol can be released into the room air [1].

High voltage electrostatic field painting is based on the creation of a field by applying a negative charge to the sprayed paint and varnish material and a positive charge to the product to be painted. When applying paint material, its loss does not exceed 5–10 %. For the application of primers and single-layer coatings on small and medium-sized products of simple and medium complexity, the painting method is used by dipping and spraying, followed by exposure to solvent vapors. The disadvantages of these methods are large losses of the solvent, which lead to significant air pollution.

Application of powder polymers, followed by heat treatment of products allows to obtain coatings of any thickness and quality. This method also improves working conditions, since the material does not contain toxic and flammable solvents. Currently, these methods of applying films are rarely used in engineering, but they will be widely used in the future.

Paints and varnishes contain film-forming bases and solvents. They can be natural and condensed resins: rosin, bitumen, glyptal, polyester, bakelite, pentaphthalic, epoxy, etc. In addition, film-forming agents include pigments, mainly metal oxides – zinc, lead, iron, titanium, aluminum, as well as clay, soot and various organic substances. For painting work, aromatic hydrocarbons are often used as solvents in engineering: toluene, xylene, solvent, alcohols (butyl and ethyl), ethers (butyl and ethyl acetates), hydrocarbons (gasoline and white alcohol). For

these substances, the sanitary norms of the design of industrial enterprises determine the maximum permissible concentrations in the air of the working area and in the atmospheric air of settlements and industrial facilities.

In recent years, there has been a downward trend in the permissible concentration value. Thus, for butyl and propyl alcohols, this value decreased by 20 times (from 200 to 10 mg/m^3), methyl alcohol and styrene decreased by 10 times, and toluene and xylene by 2 times. In this regard, the air exchange required to dissolve harmful substances to an acceptable concentration when working with VL-02 soil increased from 2,300 to 25,000 m^3 per 1 kg of paint. A similar feature occurs for paints and varnishes, including 646, 647, 648, 650, RDV, R-4, etc. Vapors of these solvents with air form an explosive mixture.

In recent years, water-based paints and varnishes have been developed and a method of applying them by electrodeposition has been proposed. At the same time, working conditions will improve significantly. However, this method has not yet found a proper distribution in mechanical engineering.

Multicomponent solvents contain both latent components and diluents, as well as the main active component, the content of the former, in some cases, can reach 50 %. The use of latent solvents (for example, alcohols), as well as diluents, reduces the total cost of the solvent and allows the use of 2–3 types of polymers of various nature as a film-forming mixture [3].

It is the presence of several components of solvents 646 and 647 that contributed to obtaining such high technical characteristics. These types of solvents are considered the most popular, and their scope is growing every year.

Solvent 646 technical characteristics, composition, application. Solvent 646 according to GOST is a colorless or yellowish liquid that has a specific odor. It is used both in everyday life and in industry for degreasing and diluting paints. With the help of solvent 646, it is possible to bring paintwork materials to the required viscosity. They are also good at cleaning stains of organic origin and washing various painting tools.

Thinner 646 is very versatile and effective due to its chemical composition. This is a multicomponent solvent, therefore, it contains several simpler solvents: 15 % ethanol, 10 % butanol, 50 % toluene, 7 % acetone, 10 % butyl acetate and 8 % ethyl cellosolve.

A good reputation and huge demand, this brand of solvent has earned due to the following features:

1. Very wide scope. It is excellent for diluting varnishes, primers, putties and enamels. It is used during the implementation of repair and construction works of buildings and premises for various purposes, in the process of painting cars, degreasing surfaces, cleaning tools.

2. Availability. You can easily buy it in every building material store.

3. Ease of use. You do not need to have special knowledge to use Thinner 646. Its complex composition reduces the risk of chemical burns and greasy marks to a minimum.

4. Acceptable price. You should be aware that using the p 646 solvent, its technical characteristics are more than excellent for such a low price.

Like any chemical substance, it also has some disadvantages: a sharp and specific odor, toxic, flammable.

Solvent 646 is a compound of several volatile organic substances that has the following physical and chemical properties:

– flash point – 7 °C;
– self-ignition temperature +4037 °C;
– boiling point +59 °C;
– density – 0,87 g/cm^3;
– it does not gain viscosity and does not freeze.

In addition, it will not be superfluous to look into the passport of this substance, although most of the numbers will not say anything to an ordinary person, but a production technologist can prohibit and give recommendations for use based on these parameters.

The p6 grade solvent has the following characteristics:

– acid number – 0,06 mg KOH/g;
– mass fraction – 0,09 %;
– volatility (according to ethyl ether) – 12;
– dissolving action – does not leave whitish and dull spots;
– number of coagulation 40 g/o;
– specific weight – 0,68 kg/l.

A solvent is used for the production and work with various coatings, including the nitrocellulose group of paints. P-646 is needed either for dilution before use, or during the production process. In addition to the nitrocellulose group of paints, it is also used to dilute acrylic and melaninoamide paints and varnishes.

When working with Thinner 646, be sure to use a respirator and wear rubber gloves. Good ventilation is also very important. Special goggles will not be superfluous, since the evaporation of the solvent affects not only the respiratory system, but also the eyes.

General information about solvent 647. Solvent 647, as well as 646, is considered one of the most popular. It is produced by many chemical enterprises and is well known to consumers. Consumer properties of a high level determined the popularity and breadth of use of this solvent.

Solvent 647 contains a mixture of organic volatile substances: ketones, aromatic hydrocarbons, ethers and alcohols. As for the chemical composition, and the percentage of various substances, the 647 solvent is very similar to 646. It

contains 41,3 % toluene, 29,8 % butyl acetate, 21,2 % ethyl acetate, 7,7 % butanol. It also contains such components as ethyl cellosolve and acetone, and is considered a more aggressive substance than solvent 646. Therefore, the use of solvent 646 is advisable where careful attitude to the treated surface is very important.

This type of solvent is used to remove paint and varnish coatings and varnishes, as well as to dissolve nitrocellulose-based film formers. It is very often used as a bodywork thinner, as it is suitable for effectively diluting nitro-varnishes and nitro-enamels used during [4]

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Повышение надежности газораспределительных систем

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Рассмотрен вопрос повышения уровня надежности газораспределительных систем путем кольцевания газопроводов, предложен подход к обоснованию принятия решения о необходимости их строительства.

Как при строительстве параллельных участков газопроводов (лупингов) или модернизации трубопроводов вставками большего диаметра, так и при строительстве кольцевых газопроводов (закольцовок) в первую очередь руководствуются результатами гидравлического расчета газораспределительной сети с учетом как существующих, так и возможных перспективных по-