

Technology Obtaining Composites for Processing of Metals on the Base of Local Raw Materials

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Obtaining cheap and high-quality dry lubricant compositions based on local raw materials for stretching wires in the technology of obtaining small-sized wires from large-diameter wires. Dry lubricant obtained on the basis of local cheese is used for processing and drawing metals prepared from the following components: sodium soap, natriy sulphate Na_2SO_4 - 5.0-20.0; bura $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ - 0.1-5.0 and talc. At present, the pilot-test work was carried out at a private company "DAVR METALL" in Namangan.

Keywords: Sodium sulfate; sodium tripolyphosphate; sodium carbonate; modification; stearic acid; calcium stearate; magnesium.

1. INTRODUCTION

The number of small industries engaged in metal processing has been growing since independence. This requires entrepreneurs to

produce competitive products that meet the requirements of world standards [1].

At present, the main products for the production of such competitive products are imported, which

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leads to an increase in the cost of the finished product. In the technology of obtaining small-sized wires from large-diameter wires, dry lubricant compositions are widely used in the stretching of wires. In turn, dry lubricant compositions are not produced in Uzbekistan and are imported from a number of foreign countries, including China, Russia and Ukraine, at around \$ 6 / kg. Examples include a number of small businesses and state-owned enterprises that produce steel wires of various sizes. At the same time, steel wires of different diameters produced by enterprises are used in construction, radio-electrical engineering, chemistry and almost all branches of industry.

Dry lubricant oils with the following composition have been developed for elongation of winding wires, mass%: five molecules of aqueous boron (pentahydrate) $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$ - 60.0-90.0; sodium tripolyphosphate $\text{Na}_5\text{P}_3\text{O}_{10}$ - 8.0-12.0; trisodiumphosphate Na_3PO_4 - 8.0-12.0; sodium sulfate Na_2SO_4 - 13.0-35.0; sodium carbonate Na_2CO_3 - 3.0-11.2; bone glue - 0.01-1.0; the rest is water [2]. The disadvantage of this composite is that it is expensive, requires the use of soap for additional lubrication, and can not be used in the manufacture of wire from mechanically cleaned rods (a device for passing wires through a small hole). There is a dry lubricant composite used to stretch the wires, mass%: calcined soda Na_2CO_3 5.0-20.0; sodium nitrite NaNO_2 0.5-7.0; sodium sulfate Na_2SO_4 5.0-20.0; borax $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ 0.1-5.0; magnesium (activated) MgO 1.0-5.0; boron nitride BN 0.05-3.0; the rest is stearic acid $\text{C}_{17}\text{H}_{35}\text{COOH}$ [3]. The disadvantage of this well-known dry lubricant composite is that it can only be applied by phosphating and cannot be used in the process of stretching the wires after mechanical cleaning of the rods. Analysis of the literature shows that despite the large number of lubricant composites used in metal processing, there are various disadvantages: lubricant melts and hardens due to heat loss during wire stretching, defects in wires and wire breakage during stretching [4-8].

The availability of raw materials and secondary products for the production of dry lubricants in the country leads to the possibility of production of various chemical reagents, the independence of raw materials, the utilization of local secondary products and, consequently, the production of low-cost products.

Due to the presence of products in the composition of dry lubricant in the territory of the

republic, as a result of its localization, in the production of a new type of dry lubricant composition on the basis of local raw materials is one of the current issues. This, in turn, leads to the production of import-substituting products and savings in the foreign exchange fund. In addition, the planned cost of the product will be around 1\$/kg, and the product will be environmentally safe, and its efficiency will not be less than that of similar products.

However, there is a limit to how long they can be used. Lubricant composites, which adhere to the surface of steel wire in a thin layer, have a certain elongation limit. If this limit is exceeded, the stretched steel wire, ie the quality of the product, may not meet the requirements. Lubricant composites with a certain composition fully meet the requirements of physical-mechanical, environmental and fire safety [9-12].

Such steel or other metals are not suitable for similar consumption. If we look at it in magnification, it can be as follows (Fig. 1).



Fig. 1. The state in which lubricant composite is not used

If the elongation process is carried out using a lubricant composite, then the magnified appearance of the product obtained can be as follows (Fig. 2).



Fig. 2. The state in which the lubricant composite is used

This paper presents the possibilities of obtaining a valuable product (or products) from a cheap source of raw materials.

2. MATERIALS AND METHODS

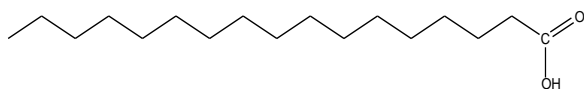
The materials of research are: household laundry soap, calcium hydroxide ($\text{Ca}(\text{OH})_2$), borax

($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$), stearic acid ($\text{C}_{17}\text{H}_{35}\text{COOH}$), calcium stearate ($(\text{C}_{17}\text{H}_{35}\text{COO})_2\text{Ca}$), sodium sulfate (Na_2SO_4), sodium carbonate (Na_2CO_3) and magnesium (MgO). The research was conducted in a laboratory setting. Sodium soap is crushed and dried at room temperature. Based on the calculations, the reagents were mixed at the optimum temperature using a reactor and a dry lubricant composition was prepared. All substances were measured with high accuracy on an electronic analytical balance.

3. RESULTS AND DISCUSSION

Modifications of all types of lubricant composites are possible. This is done by changing the basic parameters of lubricant composites or by adding special additional components.

The proposed composite calcium was obtained on the basis of the stearic acid salt, which was first synthesized from stearic acid from soap. Stearic acid is a saturated monobasic fatty acid containing $\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-COOH}$ ($\text{C}_{17}\text{H}_{35}\text{COOH}$).



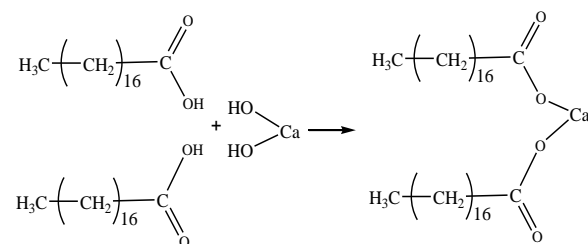
Stearic acid is mainly obtained by hydrolysis of fats in industry. Stearic acid is oily, solid at room temperature.

We hydrolyzed the stearic acid in the laboratory under acidic conditions. The stearic acid rises to the surface of the solution and is removed with a filter paper. The resulting acid is dehydrated in a drying oven without reaching the melting point.

The resulting stearic acid was extracted and dried again. It was found that its water content is 28%. When thawed, re-hardened, and pulled at temperatures above 100°C , we found that the mass was reduced by 5%. It turns out that the resulting stearic acid contains $28 + 5 = 33\%$ moisture.

Synthesis of calcium stearate: 32 grams of stearic acid obtained from the above experiment, the mass of calcium hydroxide required to convert this acid to calcium stearate is determined by the reaction equation (Fig. 3).

To carry out the saponification reaction, the synthesized stearic acid was added to a heat-resistant vessel, melted and heated to about $120\text{-}140^\circ\text{C}$ until liquefied.



The heated saturated fatty acid was sprinkled with alkali and stirred vigorously, taking small precautions. The resulting calcium soap, due to its higher melting point than fatty acids, solidifies and begins to separate. As the container is tilted, the calcium stearate is collected at the top of the container and the alkali is added to the liquid fatty acid at the bottom. The process continues in this way. When the process is complete, the calcium soap is collected and weighed. The calcium stearate salt obtained by this method is shown in Fig. 3.



Fig. 3. Calcium stearate

All dry lubricant composites proposed in this study include household soaps containing 65-70% fatty acids. Soap is a surfactant as well as the most suitable component for lubricant composite. This was also mentioned in the literature review. Calcium stearate and sodium soaps are also added to motor oils. For this purpose, they serve as a lubricant composite for engine pistons.

3.1 Preparation of the Product

To prepare the composite, lubricant first selected high-quality household soap and scraped it using a special scraper. The shavings contain a large amount (15-30%) of water, and it is advisable to use a drying cabinet to partially get rid of it. If drying is not possible in the oven, it is also possible to dry in the open air in the sun.

This dried mass contains a certain amount of water, which is completely eliminated during the thawing process.

400 g of soap scrap were obtained for the experiment. The scales were weighed and weighed 328 g. It can be seen that the soap used contains 18% moisture (Fig. 4). When the soap was diluted and weighed again, it weighed 312g. It can be seen that the soap has a moisture content of $400-312=88,88/400 = 0.22$ by mass. The bottom line is that the soap contained 22% water.

3.2 Preparation of the Composite

The quantitative composition of the substances was obtained in the following percentages

relative to the mass. Calcium stearate is obtained by 20%, soap by 23%, borax by 4%, talc by 5%, kaolin by 5%, iron (III) oxide by 5%, lime powder (CaO) by 20%, and potassium fluoride by 8% (Fig. 5).

Calcium stearate was added to the sand bath and heated slowly. In this process, it is important to ensure that the temperature does not exceed 190°C. When the calcium stearate was completely dissolved, soap powder was added and dissolved completely. The remaining additives were then added one by one to the mass and mixed vigorously. The additional components were mixed with a completely oily liquid to form a homogeneous system for 120 minutes.

The product cooled and began to solidify into a monolith. The resulting monolithic product was ground in a porcelain mortar and pulverized.

The most important parameter of lubricant composite is its adhesion to the surface of steel wire. To test this, a powder-coated steel wire was placed on the lubricant composite. The powder was then applied to the surface of the steel wire in a thin layer.

Increasing the amount of talc magnesite and kaolin in the composition, preparing the fraction in the size of 300-400 microns and less accelerates the adhesion of the product to the metal wire, improves the adhesion of the product to the metal wire, prevents metal corrosion and improves the quality of elongated wire. Lubricant composite does not boil at high melting temperatures, does not decompose, and does not crumble during elongation.



Fig. 4. Dried soap scrap



Fig. 5. Ingredients for lubricant composite

4. CONCLUSION

The proposed product serves as a dry lubricant composition in the process of stretching various types of steel wires. The product does not adversely affect the quality of the metal during the elongation of the wires and ensures a smooth elongation. In addition, there are significant economic benefits to the company by reducing the cost of stretched wires.

As a result of the implementation of this technology and the launch of production, a new type of product will be produced on the basis of local raw materials. This, in turn, leads to the production of import-substituting products and savings in foreign exchange reserves. In addition, 86% of raw materials for the production of dry lubricant composition are available in the country. The product is environmentally friendly and no less effective than its analogues. Optimal conditions for the production of dry lubricant compositions used in the processing of non-ferrous and ferrous metals on the basis of local secondary raw materials have been developed. Their production is carried out in simple typical reactors. This, in turn, indicates that the process is not complicated.

The proposed dry-lubricating compositions ensure that the quality of the metal does not deteriorate during the elongation process, and

that the elongation is smooth. and at the same time, a new technological line will be created using less sophisticated, conventional chemical industry equipment, and the production of new products for our republic will be launched.

The introduction of the proposed technology will produce products that are new to the metalworking industry. As a result, the economic performance of the manufacturer grows. In the steel wire industry, wires with a larger diameter are made by stretching a larger diameter steel wire. The process is based on passing a large diameter wire through a hole with a smaller diameter, i.e. a filler.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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