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LUBRICANTS

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This invention relates to lubricants, and more particularly to cutting oils used for drilling, thread cutting and similar lathe machine work.

The use of cutting oils in ordinary operations of machine shops is well known. The function of the cutting fluid is usually two-fold; that is, as a cooling agent to keep the drilling or cutting tools from over-heating, and as a lubricant to alleviate friction between the contacting parts. The requirement of a good cutting fluid is, therefore, that it provide a certain degree of cooling, and especially that it have sufficient oiliness to adhere to the working parts and reduce the friction to a minimum. Sometimes it is necessary to cool the working parts with water or similar fluid having a high specific heat. In the latter practice, it is desirable that the lubricant will not wash from the metal surfaces and often preferable that it form an emulsion with the cooling agent. Straight mineral oils are ordinarily good lubricants, but they are not entirely satisfactory as cutting oils. Other sources have, accordingly, been sought, or the mineral oils have been treated to transform them into satisfactory lubricants for this purpose.

Various methods of treating mineral oils to produce satisfactory cutting oils have been employed heretofore. Certain animal oils, such as lard oil, because of their oiliness have been blended with mineral oil to confer greater efficiency upon the lubricant. The quantity of lard oil required is usually quite large, thereby making the cutting oil somewhat expensive. Emulsifying agents such as soaps have sometimes been added to mineral oil to produce a cutting oil which will have increased oiliness, and more especially to confer upon the oil the property of emulsifying with cooling fluid which may be added. In this way, instead of the oil entirely washing away when a cooling agent is applied, an emulsion is formed which contains sufficient oil to provide a certain degree of lubrication. Sulphurized oils comprising vegetable oils or mineral oils, with limited quantities of sulphur incorporated therein, have also been used to advantage to increase the viscosity, oiliness and emulsifying properties of cutting oils. The efficiency of the latter type of oils has very largely depended on the sulphur content, which has been somewhat limited due to the low solubility of sulphur in the oil and the inability to incorporate large quantities therein.

The present invention has to do with an improved sulphurized mineral cutting oil prepared in a novel manner and possessing stability and having a suitable sulphur content. Cutting oils comprising mineral oil, sulphur and a sulphur solvent are old in the art and no claim is made to such a product, but, as far as I am aware, no cutting oil comprising sulphurized mineral oil and containing the high percentage of sulphur of my product in stable form has been successfully prepared prior to the invention. Furthermore, incorporation of sulphur into mineral oils to prepare cutting oils is recognized as old in the art, but all the prior methods, to the best of my knowledge, have involved treating the oil in the presence of free sulphur, at various temperatures, under atmospheric pressure, whereby only limited amounts of sulphur are incorporated therein and then usually in quite unstable form. One of the important features of my process that is considered novel and which has produced unexpected results, resides in the incorporation of the sulphur into the oil under substantial superatmospheric pressure.

More particularly, according to the invention, a mineral oil, preferably having a viscosity of at least or exceeding 70 seconds Saybolt at 100° F., is mixed with sulphur and the mixture heated under pressure to a temperature in excess of 300° F., preferably 400° F. to 600° F. The pressure may be applied from an extraneous source, but it is usually more convenient to allow the mixture to build up a self-generated pressure by the evolution of reaction gases, such as hydrogen sulphide. A pressure of about 75 to 150 lbs. per sq. in. or above may be used, although best results have been obtained with a pressure of approximately 100 lbs. per sq. in. The viscosity of the oil is usually increased considerably by the incorporation of sulphur therein. This increase may range from 25 to 100 seconds Saybolt or more. It is preferable that the finished product have a viscosity in excess of 75 seconds Saybolt at 100° F. The amount of sulphur retained by the oil may range from about 1.5 to 5% and preferably about 2–4%.

According to one method of operation I may prepare my improved cutting oil in batches wherein an ordinary shell still capable of withstanding considerable superatmospheric pressure is charged with a suitable mineral oil, say a stock having a Saybolt Universal viscosity of about 100 at 100° F., and heated in the presence of 4–8% by weight of sulphur. A suitable average temperature is about 450° F. during the operation and the vapors and gases evolved are preferably confined so that a pressure of about 100 lbs. per sq. in. is maintained on the system. The product at the end of two hours is found to contain about 2–4%

of sulphur. In one operation a sample of 100 viscosity stock having a natural sulphur content of about 0.4% was heated to 450° F. for two hours under 100 lbs. pressure and the resulting product was found to contain 2.51% sulphur.

The method I prefer to use and the one I have found to be most successful commercially, however, is a continuous operation in a tube still wherein a mixture of sulphur and oil in proper proportions is charged to a preheater and then transferred, after a suitable temperature is effected, to a reaction chamber. According to this method of operation a 100 viscosity stock containing 4% of suspended sulphur is charged to the preheater of a tube still and the temperature of the mixture raised to about 500° to 600° F. The preheated mixture is transferred to a reaction chamber in which a body of oil is maintained and from which the product is drawn off continuously. A pressure of 100 to 150 lbs. per sq. in. is maintained on the system by a control valve for releasing tail gases. The charge rate will obviously vary with the size of the equipment used. In one operation a stock having 120 Saybolt Universal viscosity at 100° F. containing in suspension 4% of sulphur was charged at the rate of 4 bbls. per hour to the preheater of a small tube still. The oil was preheated to 550° to 600° F. and a pressure of 100 to 150 lbs. per sq. in. was maintained on the system. The finished material had a viscosity of 152 and a sulphur content of 3.42 whereas the original oil had a sulphur content of only 0.39%.

The reaction between the sulphur and oil has been found to liberate large quantities of reaction gases, such as hydrogen sulphide, which normally escape but under pressure either combine with or in part may remain dissolved in the oil after the pressure is released. The latter is particularly true when the reaction period provides insufficient time for complete absorption of the sulphur by the oil. The hydrogen sulphide imparts a disagreeable odor if allowed to remain in the finished product. It is preferable, therefore, to remove the dissolved gases as completely as possible. This may be done by applying a vacuum to the oil to draw out the dissolved gases or to blow a stream of gas, such as air, through the oil to carry out the hydrogen sulphide. It may be desirable in some cases to mix substances with the mineral oil and sulphur mixture, which will absorb or destroy any foul gases. Sulphur dioxide has been suggested for this purpose. Furthermore, it may sometimes be advantageous to add materials which not only are capable of absorbing sulphur and destroying the foul odor of the sulphur containing gases, but also will give a positive and more pleasant odor to the finished product. Pine tar has been used with this object in view.

A preferred method which I have found particularly valuable for improving the quality of the sulphurized oil is to provide in the sulphurized product, after settling if necessary to remove suspended material, a small percentage of pine oil. The amount of pine oil should be controlled so that the viscosity of the final product is not changed substantially. In general about 1 to 5% of pine oil is satisfactory and preferably about 2%. In case the viscosity of the sulphurized oil is not much above 150 the blend should usually have a viscosity of about 140–150 at 100° F. For example, the sulphurized product from the tube still, as described above, and having a viscosity of 152 was blended with 2% of pine oil and the resultant blend had a viscosity of 147–148.

The addition of pine oil has several advantages among which may be mentioned the effect of improving the odor and stability of the finished product. The pine oil destroys the odor of sulphurous gases, such as hydrogen sulphide, and also stabilizes the oil against sludge formation. Oils containing the pine oil have been found to deposit substantially no sludge on storage for several months whereas without the pine oil the product often deposits considerable quantities of sludge. The oil may be filtered, if desired, prior to the addition of pine oil to remove any suspended particles and such a procedure is contemplated if necessary.

It is sometimes advantageous for some kinds of work to have a light colored cutting oil in order to view the cutting operation better. Also it is desirable that a cutting oil should not possess a sticky character which would cause excessive consumption and labor to clean the metal after the cutting operation. In order to improve the cutting oil in the aforementioned respects I have found that it is sometimes advantageous to acid treat the sulphurized product. In one case where a light colored oil was desired a portion of the cutting oil prepared by the tube still method as described above, and prior to the addition of any pine oil, was treated with 15 lbs. per bbl. of 98% sulphuric acid. The treated oil had a deep red color and sulphur content of 2.77% as compared with a substantially black color and sulphur content of 3.42% of the oil before acid treatment. The film strength of the oil was improved by acid treatment as well as the color and stickiness. It is to be understood that the quantity of the acid given above is not a limitation on the invention since any suitable quantity may be used to give the desired properties providing the sulphur content is not decreased too extensively. If too large quantities of acid are used the sulphur may tend to crystallize out. Also, other strengths of acid, such as 66° Bé., may be desirable for use in some instances. It is usually unnecessary to add pine oil to the acid treated product although it may be desirable in some instances.

While the invention has been described with particular reference to the treatment of lighter grades of lubricating oils for the preparation of cutting oils, it will be understood that the invention is not so limited, but instead may also be applicable to the treatment of other hydrocarbon oils, such as lubricating oils and like heavier lubricants, for the preparation of gear lubricants, greases, etc.

This application is a continuation-in-part of Serial No. 502,256, filed December 13, 1930, which has matured into U. S. Patent 1,929,955, dated October 10, 1933.

Obviously, many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. The method for the continuous manufacture of sulfurized hydrocarbon oils, which comprises mixing free sulfur with the oil and passing the resulting mixture through a preheater wherein the mixture is raised to a reaction temperature of about 400°–600° F., transferring the hot products from the preheater to a reaction chamber

wherein said products are maintained at a reaction temperature for sufficient time to effect sulfurization of the oil, maintaining a substantial superatmospheric pressure on the products in said reaction chamber, and withdrawing a sulfurized oil from the reaction chamber.

2. The method for the continuous manufacture of sulfurized cutting oils, which comprises forming a suspension of about 4% free sulfur in a light hydrocarbon lubricating oil, charging the resulting mixture to a preheater wherein the mixture is raised to a reaction temperature while passing through a heating coil, transferring the preheated products to a reaction chamber wherein the products are maintained at a reaction temperature of upwards of 400° F. and under a pressure of at least about 100 lbs. per sq. in. for sufficient time to effect sulfurization of the oil, and withdrawing a sulfurized oil from said reaction chamber.

3. The method for the continuous manufacture of sulfurized cutting oils, which comprises forming a mixture of light lubricating oil and free sulfur in sufficient amount to produce a sulfurized oil of about 2–4% sulfur content, charging the mixture to a preheater wherein the mixture is rapidly raised to a reaction temperature, transferring the hot products to a reaction chamber wherein sulfurization is effected under a temperature of about 500°–600° F. and a pressure of about 100–150 lbs., withdrawing the products from the reaction chamber, reducing the pressure and separating gases and sludge from the sulfurized oil.

4. The method for the continuous manufacture of sulfurized cutting oils, which comprises forming a mixture of light lubricating oil and a small proportion of free sulfur, passing the mixture through a preheater wherein the temperature thereof is rapidly raised sufficiently high to cause sulfurization of the oil, transferring the hot mixture to a reaction chamber and maintaining the mixture at a reaction temperature and under a pressure of upwards of 75 lbs. per sq. in. for sufficient time to effect sulfurization of the oil, withdrawing the reaction products from the reaction chamber, releasing the pressure and separating fixed gases and suspended matter from the sulfurized oil, and adding about 1–5% of pine oil to the sulfurized oil to effect stabilization against sludge formation.

5. The method for the continuous manufacture of sulfurized cutting oils, which comprises forming a mixture of light lubricating oil and a small proportion of free sulfur, passing a stream of the mixture through a preheater to raise the temperature thereof sufficiently high to induce reaction, transferring the preheated products to a reaction chamber wherein sulfurization occurs while maintaining a pressure of upwards of 75 lbs. per sq. in., withdrawing the product and separating gases and suspended matter from the sulfurized oil at a reduced pressure, and subjecting the resulting sulfurized oil to an acid treatment with strong sulfuric acid to improve the color and effect stabilization against sludge formation.

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