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MANUFACTURE OF LUBRICANTS

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This invention relates to the manufacture of lubricants and particularly to the manufacture of synthetic lubricating oils having special properties adapting them to the lubrication of certain types of machinery, such as automatic variable speed power transmissions. In continuous automatic variable speed power transmissions employing extremely high pressures between metal surfaces such as at contact points between balls, rollers and races it is necessary to use a lubricant to prevent "galling". However, it is essential to avoid the use of a lubricant which will cause slipping between the surfaces at the contact points, thereby preventing the transmission of power through the mechanism. A machine for testing lubricants for this purpose is described in United States Patent No. 2,045,555, issued to J. D. Almen, June 23, 1936.

From a study of a large number of lubricating oils for this purpose applicants have discovered that certain types of synthetic lubricating oils are especially valuable and more effective than any of the natural oils or the synthetic oils known to the prior art. The synthetic oils they have investigated were manufactured by the catalytic polymerization of unsaturated hydrocarbons in accordance with the general method described by Brownlee United States Patent 1,309,432, issued July 8, 1919.

We have discovered that synthetic oils prepared from distillates produced by high temperature cracking or "reforming" of gasoline and especially heavy naphtha are especially valuable for our purpose. We have also discovered that the co-polymerization of reformer distillate with pinene or turpentine likewise produces a superior oil for lubrication of automatic variable speed power transmissions. By "co-polymerization" we mean that the liquids are mixed and treated together with a catalyst with the result that they interact to form new chemical products.

In carrying out our process we prefer to subject a heavy naphtha, for example Mid-Continent heavy naphtha, to a reforming-cracking operation at a high temperature of about 1000–1150° F. and preferably at a pressure of about 500–1000 pounds per square inch. Lower pressures, however, of the order of 100 pounds per square inch may be employed. The stock used in this reforming operation may suitably be a heavy naphtha having a boiling range of 250–450° F. Somewhat lighter stocks having a boiling range of 200–400° F. may likewise be employed. Cracking may be carried out in a coil or coil and drum apparatus wherein the naphtha is forced through a long coil placed in a furnace and rapidly heated to the desired temperature above 950° F. and the naphtha vapors passed through a "soaking section" of the coil where the temperature is maintained at the desired cracking temperature, for example 1050° F.

The resulting distillate is fractionated to separate high boiling constituents and gases and the highly unsaturated hydrocarbons boiling mostly within the gasoline boiling range are subjected to polymerization with aluminum chloride or other suitable active halide catalyst such as aluminum bromide, boron fluoride, etc. From 2–5% of catalyst may be used and the catalyst should be agitated with the unsaturated hydrocarbon distillate while maintaining the temperature at 100–300° F. A temperature of 150° F. is satisfactory and the polymerization reaction may be hastened by the use of a promoter such as HCl or aliphatic chlorine compounds, carbon tetrachloride, etc. If desired, the entire product of reforming may be employed and maintained under pressure, only the heaviest tar and the fixed gases being removed.

After completing the polymerization, which may require several hours, the catalyst is separated from the oil as a sludge and the oil is neutralized and washed in the regular manner. Low-boiling and unchanged hydrocarbons are removed by distillation and the distillation may be carried on until the viscosity of the residual oil is about 65 seconds Saybolt at 210° F., although viscosities of about 50 to 100 seconds Saybolt are suitable. The synthetic oil obtained in this manner is free from paraffin wax and possessed of a low pour point which is substantially determinable by the increase in viscosity of the oil at low terperatures. The oil is also characterized by a low viscosity index as calculated by the method of Dean and Davis, Chem. & Met. Engr., October 1929, page 618. The viscosity index of our special synthetic oils will usually be negative and may be as low as —70 to —100.

The addition of pinene and turpentine to the reformed naphtha distillate still further improves the resulting synthetic lubricating oil product and up to 40% of pinene may be employed in this way, although we prefer to use about 10–20%. We may use the turpentine in place of pinene with good results. The following table gives the results of a number of tests made with our synthetic lubricating oils derived from a variety of stocks by the method

above described. The "torque ratio" is the ratio of the torque obtained in the test of the lubricating oil in question compared to a standard lubricating oil which was the best natural lubricant discovered for this purpose obtained from a Coastal crude. Wherever the expression "torque ratio" is used herein it will be understood to mean the ratio of the effective torque of the oil in question compared to this standard oil determined with the Almen machine. The data are presented on the basis of a torque ratio of 1 for the standard.

	Viscosity index	Yield percent	Torque ratio
Synthetic oil from—			
Ordinary pressure gasoline from gas oil	+30	16	1.02
Heavy dist. from cracked gas oil	−30	22	0.90
Cracked paraffin wax	110	15	0.74
Reformed gasoline	−70	10	1.10
Reformed gasoline+10% turpentine	−20	14	1.11
Reformed gasoline+20% turpentine	−40	17	1.17
Reformed gasoline+40% turpentine	−50	16	1.14
Comparative oils:			
Solvent extract from Mid-Continent lubricating oil refined	20		0.95
East Texas lubricating oil	76		0.95
Lard oil			0.54

Although the differences in torque as indicated by the above ratios are in some cases relatively small, small differences represent a very large difference in the size of the equipment required to transmit a given amount of power.

It should be understood that we may blend our synthetic oils with various other lubricating oils and similar materials in preparing our novel power transmission oils. For example, we may blend them with various natural oils such as the East Texas lubricating oil referred to in the foregoing table. We may also blend them with certain modifying agents such as pour test depressors, for example, soaps, zinc hydroxy stearate, aluminum naphthenate, etc., synthetic hydrocarbon resins such as the polymerization products of chlorinated paraffin wax and naphthalene, etc. in relatively small amounts usually of the order of 1–2% or less. We may also modify our synthetic oils with other synthetic oils with other synthetic hydrocarbons such as the polymerization products of isobutylene, especially those obtained by the action of active metal halide catalysts, aluminum chloride and boron fluoride which give hydrocarbon oils and plastics at various temperatures, especially at low temperatures of the order of −40 to −100° F. Calcium and sodium soaps may be added as body agents to produce a heavier product resembling the greases.

Although we do not know the exact reason for the improved behavior of our synthetic oils from reformed naphtha or turpentine, we believe that the effect may be associated with the low sulfur content of the synthetic oils, in combination with low viscosity index, and the peculiar property of the synthetic oils of decomposing under conditions of high temperature. We have observed that synthetic oils made by polymerization processes such as the process described herein undergo a depolymerization at elevated temperatures, for example, at temperatures of the order of 600° F. and in some cases even much lower temperatures of the order of 400° F. It is therefore possible that our synthetic oils undergo a decomposition at the point of contact between the surfaces of balls and races, thus increasing the friction and therefore the torque obtainable in this particular type of service. It should be noted that this requirement is directly contrary to the requirement for those lubricants employed in ordinary extreme pressure lubrication, for example in the lubrication of hypoid gears, metal cutting tools, etc., where it is desired to obtain maximum lubrication at points of high pressure. It is also possible that our synthetic oils do not increase in viscosity with extremely high pressure in the same manner as ordinary oils and therefore they do not provide the undesirable lubrication which causes slipping at points of extremely high pressure in the power transmission mechanism. We do not intend, however, that our invention be limited by any theory advanced herein but only by the extent of the following claims.

We claim:

1. The process of producing lubricating oils adapted for the lubrication of automatic variable speed power transmissions comprising subjecting a petroleum naphtha boiling within the gasoline boiling range to a reforming operation whereby the unsaturation of said naphtha is substantially increased, subjecting the reformed naphtha to the catalytic polymerizing action of an active metal halide whereby said unsaturated hydrocarbons are substantially polymerized to higher molecular weight lubricating oils, separating the resulting polymerized oil from sludge and removing the unchanged naphtha from the lubricating oil products.

2. The process of claim 1 wherein the active metal halide is anhydrous aluminum chloride.

3. The process of claim 1 wherein the reformed naphtha is a product of reforming at temperatures between 1000 and 1150° F.

4. The process of claim 1 wherein the reformed naphtha is a product of reforming a petroleum naphtha having a boiling range between 200 and 450° F.

5. The process of producing lubricating oils adapted to the lubrication of automatic variable speed power transmissions, comprising subjecting an unsaturated hydrocarbon distillate selected from the class consisting of reformed naphtha and mixtures of reformed naphtha with pinene to the catalytic polymerizing action of an active metal halide whereby unsaturated hydrocarbon constituents are polymerized to higher molecular weight lubricating oil, separating the resulting polymerized oil from catalyst sludge and removing unpolymerized hydrocarbons from the lubricating oil product.

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