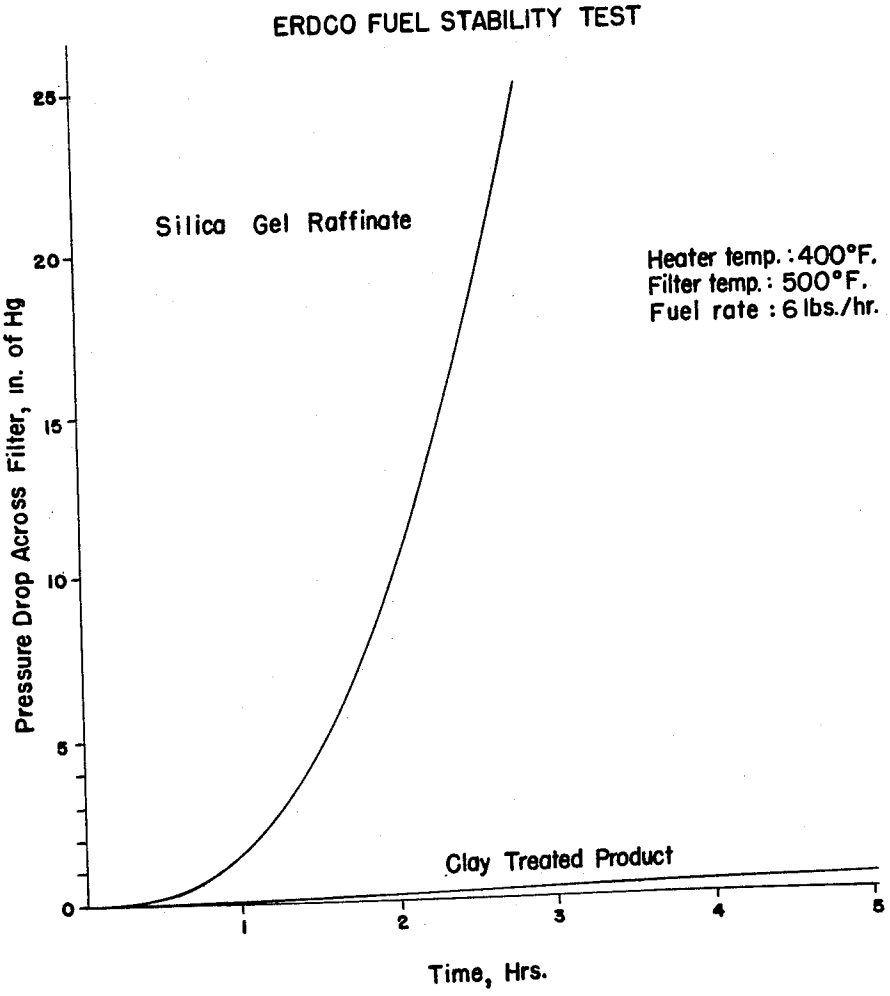
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PREPARATION OF JET OR ROCKET FUELS

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PREPARATION OF JET OR ROCKET FUELS

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1 Claim. (Cl. 208—295)

This invention relates to the preparation of rocket and jet aircraft fuels of high thermal stability.

A major problem faced by refiners in the manufacture of jet aircraft fuels is the production of fuels of this type which have adequate thermal stability. Jet aircraft in supersonic flight are subjected to high temperatures, and it is necessary that heat developed at certain component parts of the aircraft be removed. One manner of achieving heat removal is to absorb heat in the fuel as it flows to the burner and thus utilize it as a heat sink. It is accordingly essential that the fuel have a high degree of thermal stability at the temperatures reached; otherwise, the heat absorbed will cause the formation of sludge in the fuel, and this insoluble matter may cause fouling of fuel filters and burner nozzles.

Petroleum distillate fractions which have suitable boiling range properties for use as jet or rocket fuels, such as fractions boiling within the range of 150–600° F., generally do not have the desired thermal stability characteristics. Hydrocarbon fractions which have not been subjected to some special treatment are prone to undergo sludge formation at the temperatures encountered at supersonic speeds. Such fractions also generally have too much tendency to produce a smokey flame in jet or rocket engines, which difficulty is attributed to aromatic constituents of the fuel. Jet fuel stocks accordingly have been subjected to special treatments to reduce the aromatic hydrocarbon content and to improve high temperature stability characteristics. The reduction in aromatic content conventionally has been effected by solvent extraction and can also be accomplished by hydrogenation. Prior proposals for reducing the sludging tendency of jet fuel stocks have involved the use of various additives as sludge inhibitors or hydrogenation of the stocks to remove trace constituents, such as sulfur or nitrogen compounds, which are thought to promote sludging.

The present invention is directed to and provides a process for producing jet or rocket fuels having unusually good thermal stability as well as low smoking tendency. According to the invention a distillate hydrocarbon stock of suitable boiling range is first subjected to selective adsorption by means of silica gel to reduce the aromatic hydrocarbon content to less than 7% by volume and preferably less than 5%. The treated material of low aromatic content is then subjected to treatment with an adsorptive clay, whereby its thermal stability properties are improved to a surprisingly high degree. The resulting product has outstanding characteristics for the intended use.

The step of treating the original distillate stock by means of silica gel to remove aromatic components preferably is carried out by the "Arosorb" process. This process has been fully described in an article entitled "Versatile Process for Aromatics Recovery" which appeared in "The Petroleum Engineer," April 1953, at pages C–9 to C–14. It involves a cyclic operation in each cycle of which an appropriate amount of the charge stock is introduced in liquid phase to a bed of silica gel

to selectively adsorb the aromatic components, following which a liquid desorbent is introduced into the bed to displace the charge hydrocarbons. The effluent from the bed is segregated during each cycle into two fractions, one of which is a raffinate fraction comprising mainly the non-aromatic charge hydrocarbons in admixture with desorbent and the other of which is an extract fraction comprising mainly the aromatic charge components in admixture with desorbent. The raffinate and extract products are obtained by separately distilling these fractions to remove the desorbent.

It is known that the treatment of a hydrocarbon stock with silica gel selectively removes not only the aromatic hydrocarbon components but also the trace components such as compounds containing sulfur, nitrogen and oxygen. Such compounds have considerably greater adsorbabilities than the non-aromatic hydrocarbons and are therefore selectively adsorbed by the silica gel and in that way effectively separated from the raffinate material. These trace components are generally considered to be largely responsible for the thermal instability of jet fuel stocks and hence treatment of the stock with silica gel alone would be expected to yield a product having good stability at the temperatures reached in supersonic flight. Since silica gel is a strong adsorbent as compared to adsorptive clays, it normally would not be expected that any worthwhile improvement could be effected by utilizing a clay treatment following the silica gel treatment.

I have found that contrary to expectations, treatment of the raffinate from the silica gel treating step by means of adsorptive clay is surprisingly effective in imparting high temperature stability to the jet fuel product. This is illustrated by the accompanying drawing which depicts comparative curves obtained by testing products in the Erdco Jet Fuel Coker. This testing procedure is conventionally used for determining thermal stability of fuels of the type here concerned and has been described in an article entitled "Jet Fuel Thermal Stability" appearing in "Petroleum Processing," December 1955, pages 1909–1911. The upper curve represents a JP–5 fuel prepared by treating a distillate stock with silica gel alone to obtain a raffinate product of low aromatic content. The lower curve represents the product resulting from further treatment of this raffinate product by means of adsorptive clay. Comparison of the curves shows that the clay treatment results in a marked improvement in the thermal stability of the fuel.

The clay used in the final step of the present process can be any of the conventional adsorptive clays employed in refinery practice. The treatment can be carried out by percolation filtration or by the so-called contact method. The amount of clay used will depend to an extent on the particular stock being treated and the degree of product stability desired but in any event should be at least 2 lbs./bbl. and preferably at least 20 lbs./bbl. The treating temperature employed is not critical and the treatment can be carried out at room temperature or at elevated temperatures. Increasing the temperature generally tends to reduce the clay dosage necessary for securing the desired product quality. For convenience in carrying out the treatment with clay, it is desirable to select a treating temperature below that at which the particular stock being treated begins to boil so that elevated pressures need not be used in the operation.

The following example specifically illustrates the invention:

A petroleum distillate fraction having an approximate boiling range of 400–600° F. and an aromatic content of 11% by volume was used as the starting material. This charge stock was subjected to selective adsorption

by means of silica gel in an "Arosorb" operation to obtain a raffinate fraction having the following properties: aromatic content=3%; A.P.I. gravity—46.6; flash point=about 200° F.; smoke point=35 mm.; sulfur content=0.011%. The raffinate fraction was then percolated through roasted Attapulgus clay of 30–60 mesh at room temperature until a yield of 62.6 bbls./ton of clay had been obtained. This yield is equivalent to a clay dosage of 32 lbs./bbl. of raffinate treated. The product had a smoke point of about 35 mm. and a sulfur content of 0.008%. Samples of each of the products from the silica gel and clay treating steps were tested in an Erdco Jet Fuel Coker, utilizing a fuel heater temperature of 400° F., a filter temperature of 500° F. and a fuel rate of 6 lbs./hr. The results are given by the two curves shown in the accompanying drawing. For the raffinate from the silica gel treatment pressure drop across the filter built up to 25 inches of mercury at the end of 2¾ hours, whereas for the clay treated product the pressure drop at the end of 5 hours had increased only to about 0.5 inch of mercury. These results show that clay treatment of the silica gel raffinate accomplishes a remarkable improvement in thermal stability.

I claim:

Process for making a jet fuel of high thermal stability which comprises subjecting a jet fuel hydrocarbon distillate stock boiling within the range of about 150–600° F. to selective adsorption with silica gel, separating from the silica gel a raffinate fraction having an aromatic hydrocarbon content less than 7%, and treating said raffinate fraction with adsorptive clay in amount of at least 2 lbs./bbl.

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