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PREVENTING FOULING OF HEAT EXCHANGERS

Burris F. Babin, Texas City, Tex., assignor to Pan American Refining Corporation, New York, N. Y., a corporation of Delaware

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5 Claims. (Cl. 196—134)

My invention relates to the prevention of fouling of heat exchangers and more particularly to the prevention of fouling of heat exchangers in which at least one of the liquid streams passing to the heat exchanger is a hydrocarbon fluid.

For some time it has been the custom in many processes to utilize waste heat from one part of the process in heating charge to another part of the process. This is done by means of heat exchangers in which a heated stream gives up a portion of its heat to raise the temperature of a cooler stream. In the oil refining art it often happens that one or the other of these streams contains material which deposits on the walls of the heat exchanger tube. This is known as "fouling." This fouling usually occurs on heating a relatively low temperature hydrocarbon stream by indirect heat exchange with a hotter substance, hydrocarbon or otherwise.

The fouling material usually appears as one of two types. In one type the material deposited is soft and gummy. Cleaning of the tubes by lance drills, etc., is difficult because of the tarry nature of the material which escapes through the drill and settles again on the tube walls behind the drill head. The other type of fouling material is usually deposited as a hard coke. Both types of fouling have been found to decrease the efficiency of the heat exchanger materially and reduce the amount of charge which may be put through the tubes.

It is an object of my invention to prevent or greatly retard this fouling action. Another object of my invention is to increase the lengths of runs possible before cleaning heat exchangers. A still further object of my invention is to increase available heat exchanger throughputs. It is likewise an object of my invention to increase heat exchange efficiency under the conditions previously described.

I have found that by injecting a small amount of water into the cooler stream passing to the heat exchanger the deposition of fouling material is prevented or greatly retarded and the length of time between cleanings is materially lengthened. The term "water" as used herein means, unless qualified, either liquid water or steam and either can be used, but in any case it is highly important that the water be substantially free of undissolved solids and it is likewise desirable that it be very low in dissolved solids or at least of low hardness.

The charge to a heat exchanger frequently contains suspended or occluded water which will function to some extent in a manner similar to the injection of extraneous water although this action has not previously been appreciated so far as I know. Such suspended water, however, usually contains both dissolved and undissolved solids which increase the amount of deposit and furthermore such water is not present in uniform amounts so that the effect is spasmodic and uncontrolled, thereby decreasing the over-all effectiveness.

A specific example of the application of my invention will serve to illustrate its utility. A treated furnace oil to be re-run is water washed and the entrained water allowed to settle to remove any solids, etc. The settled furnace oil is then heated in a heat exchanger and steam is admitted with the charge to the heat exchanger at a rate of about 0.5 to about 1.5 pounds per barrel of charge, preferably about one pound of steam per barrel of charge. Since the steam condenses almost immediately upon entering the oil stream, the actual effect is that of injecting pure liquid water. As a result it was found possible to increase the average charge rate over the period of a run by about 35%. Instead of shutting down for cleaning and drilling at the end of a thirty day run it was possible to obtain runs of 100 days or longer before a shut-down was necessary.

It has also been found advisable to increase the charge of steam to the feed to about 2 to about 3 pounds of steam per barrel of oil for one or two hours each day. By following this practice the pressure drop is found to be lowered as much as 50 pounds per square inch following the increased steam injection showing the considerable removal of the fouling material.

It is thus preferable to inject pure water continuously in a minor proportion and to increase periodically the amount of water thus introduced. However, considerable beneficial effects can be obtained by either the continuous introduction of water or the intermittent injection of water. The quantities given above have been found to be optimum for this particular type of liquid hydrocarbon stream under the heat exchange conditions encountered. Generally speaking, water can be introduced continuously in amounts of from about 0.25 to about 5 pounds per barrel of the charge passing to the heat exchanger or intermittently in quantities of from about 1 to about 10 pounds per barrel.

As previously indicated, the preferable procedure is to introduce the water into the stream passing to the heat exchanger. However, the water can be injected at some intermediate point

in the heat exchange process. Thus when it is desired to avoid or retard the fouling of tubes in which a hydrocarbon stream is heated, a minor proportion of water can be injected into this stream in advance of the point at which the stream tends to deposit fouling material.

It is preferred that liquid water be present in the low temperature stream passing to the heat exchange operation so that steam is formed during the heat exchange thereby giving the maximum scrubbing effect. As previously described, however, steam is a particularly advantageous source of pure water and when injected into a cold hydrocarbon liquid stream it condenses to form water and then revaporizes during the heat exchange operation.

Although I have described one specific embodiment of my invention, this is by way of illustration and not by way of limitation and I do not intend to be limited thereby except as shown by the appended claims.

I claim:

1. The method of retarding the fouling of a heat exchanger operating on a relatively high temperature fluid stream and a relatively low temperature stream of hydrocarbon material tending to deposit a fouling substance on heating which comprises injecting into said relatively low temperature stream entering the exchanger from about 0.25 to about 5 pounds of substantially pure water per barrel of said hydrocarbon material.

2. The method of retarding the fouling of a heat exchanger operating on a relatively high temperature fluid stream and a relatively low temperature stream of hydrocarbon material tending to deposit a fouling substance on heating which comprises intermittently injecting into said relatively low temperature stream entering the heat exchanger from about 1 to about 10 pounds of substantially pure water per barrel of said hydrocarbon material.

3. The method of retarding the fouling of a heat exchanger operating on a relatively high temperature fluid stream and a relatively low temperature stream of a hydrocarbon material of a type which deposits a fouling substance on heating which comprises injecting into said relatively low temperature stream passing to said heat exchanger from about 0.5 to about 1.5 pounds of substantially pure water per barrel of said hydrocarbon material.

4. The method of retarding the fouling of a heat exchanger operating on a relatively high temperature fluid stream and a relatively low temperature stream of hydrocarbon material tending to deposit a fouling substance on heating which comprises continuously injecting into said relatively low temperature stream entering the heat exchanger from about 0.25 to about 5 pounds of substantially pure water per barrel of hydrocarbon material and intermittently increasing substantially the flow of said water to said low temperature stream to a total quantity not in excess of 10 pounds of substantially pure water per barrel of hydrocarbon material.

5. The method of retarding the fouling of a heat exchanger operating on a relatively high temperature fluid stream and a relatively low temperature stream of hydrocarbon material tending to deposit a fouling substance on heating which comprises continuously introducing into said relatively low temperature stream passing to said heat exchanger from about 0.5 to about 1.5 pounds of substantially pure water per barrel of said hydrocarbon material and intermittently injecting from about 2 to about 3 pounds of substantially pure water per barrel of said hydrocarbon material.

BURRIS F. BABIN.