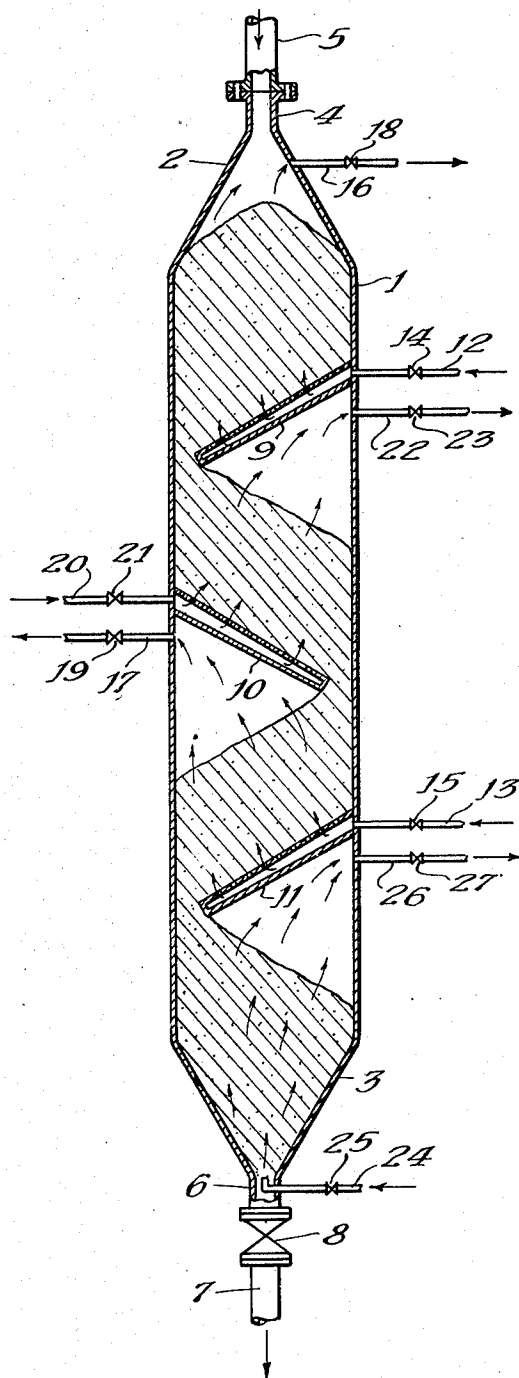


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N. K. ANDERSON
METHOD OF REACTIVATING FINELY
DIVIDED CONTACT MATERIALS
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METHOD OF REACTIVATING FINELY
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This invention relates to an improved method of regenerating finely divided solid contact material, particularly contact material which has become contaminated with combustible deposits.

In various catalytic conversion processes, for example, catalytic cracking, catalytic dehydrogenation, aromatization and the like when hydrocarbon oils are treated, the contact of catalytic material becomes contaminated with a hydrocarbonaceous deposit which gradually reduces the effectiveness of the catalyst and therefore must be removed. It is common practice to remove this deleterious material by combustion with oxygen-containing gases. My invention is concerned with an improvement in this regeneration process in connection with recently developed "moving bed" processes. By "moving bed" I mean a process wherein the contact material or catalytic agent is continuously passed through the system in the form of a compact stream either by means of gravity or by suitable mechanical equipment.

In the heretofore proposed methods of regenerating contaminated catalyst particles in this type of process, difficulties have arisen from the unduly high temperatures attained due to the combustion of the deleterious material. These temperatures if allowed to exceed definite maximums will permanently impair the activity of the catalyst.

It has been proposed that heat exchange tubes be positioned within the regeneration zone to remove the excessive heat of combustion. This solution of the problem, however, is expensive in view of the added equipment which becomes necessary. An apparatus designed for heat exchange between moving masses of solid particles and the convective fluid is limited in efficiency of heat transfer by the distances between solid particles and the heat exchange surfaces. In order to obtain reasonably efficient heat transfer in this type of apparatus, it has been found that the maximum distance between solid particles and heat transfer surfaces should be limited to something less than about two inches. This, of course, results in a complex and complicated heat exchange apparatus through which the stream of finely divided contact material is passed.

My invention is concerned with an improved method of reactivating finely divided solid contact material in the moving bed process without the danger of excessive temperatures which are damaging to the activity of the catalyst and with efficient and positive heat exchange between the

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contact material and a cooling fluid for the removal of heat of combustion.

Broadly my invention comprises passing finely divided solid contact material contaminated with combustible deposits as a continually moving stream through a series of alternate regenerating and cooling zones, contacting said material in the regenerating zone with oxygen-containing gases to effect burning of said combustible deposits and contacting said material in the cooling zone with cool, inert fluid to effect the removal of heat from the contact material and reduce its temperature to a degree sufficient to permit further burning of said combustible deposit without attaining temperatures sufficiently high to substantially impair the activity of the catalytic material.

In order to more clearly illustrate the above and additional features and advantages of my invention, reference is made to the accompanying diagrammatic drawing and the following description thereof.

The drawing illustrates in an elevational view, shown principally in section, one type of apparatus in which the process of my invention may be successfully conducted. This particular apparatus comprises an elongated shell 1 closed at its upper and lower ends by the conically shaped heads 2 and 3 respectively. Head 2 is provided with a flanged opening 4 to which an inlet conduit 5 is attached and head 3 is provided with a flanged opening 6 to which may be attached outlet conduit 7. A plurality of hollow baffles 9, 10 and 11 are positioned within the vessel and serve to divide it into a number of separate zones. The upper member of each of the baffles is provided with a plurality of perforations, the purpose of which will be hereinafter described.

In operation, solid contact material is introduced through conduit 5 and will flow downwardly through the vessel passing over the baffles and be withdrawn through conduit 7 controlled by valve 8. During the regeneration process, oxygen-containing gases are introduced to baffles 9 and 11 respectively by means of lines 12 and 13 controlled by valves 14 and 15. These oxygen-containing gases will pass through the perforations in the respective baffles and into the mass of contaminated contact material immediately thereabove. The oxygen will cause combustion of the deleterious material and the resultant combustion products are withdrawn through lines 16 and 17 controlled by valves 18 and 19. In operation, only sufficient oxygen-containing gases are preferably admitted to each of the regeneration

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zones to maintain the resultant increase in temperature of the contact material below the desired maximum. In the intermediate zone positioned immediately above baffle 10 the contact material previously heated in the zone above baffle 9 is cooled by a suitable inert fluid introduced through line 20 controlled by valve 21. After removing the desired amount of heat from the contact material, the cooling fluid is then withdrawn through line 22 controlled by valve 23. Suitable materials which may be used for cooling the contact material may comprise steam, inert gases or cooled regeneration products.

In the stripping zone disposed below baffle 11, a suitable stripping medium is introduced through line 24 controlled by valve 25 and withdrawn through line 26 controlled by valve 27. It may be desirable in some instances to additionally cool the catalyst in this zone in which case the stripping medium may be the same type of fluid as is introduced through line 20.

Allowable maximum temperatures to which various contact materials may be subjected without permanent injury, of course, vary with the particular material concerned. For instance, with synthetic cracking catalysts, allowable regeneration temperatures are on the order of 1200° F., but preferably the operating conditions are maintained below 1100° F.

The hereinbefore described drawing illustrates the use of two regenerating zones and one or two cooling zones but any other number of zones may be employed within the broad scope of the invention.

I claim as my invention:

1. A process for reactivating subdivided solid contact material contaminated with carbonaceous deposits which comprises passing the solid contact material as a continuous downwardly moving stream through a first regenerating zone, an intermediate cooling zone and a second regenerating zone in the order named, introducing a separate stream of oxygen-containing gas at one end of each of said regenerating zones to flow therethrough in contact with the descending solid material and to burn carbonaceous matter from the solid material in the regenerating zones, removing resultant combustion gases from contact with the downwardly moving stream of solid material adjacent the opposite end of each of the regenerating zones, introducing a relatively cool inert fluid at one end of said intermediate zone and into contact with the solid material passing through

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this zone to remove heat of combustion from the downwardly moving solid material in transit from the first to the second regenerating zone, and removing said inert fluid from contact with the downwardly moving stream of solid material adjacent the opposite end of said intermediate zone.

2. A process for reactivating subdivided solid contact material contaminated with carbonaceous deposits which comprises passing the solid contact material as a continuous downwardly moving stream through a first regenerating zone, an intermediate cooling zone and a second regenerating zone in the order named, introducing a separate stream of oxygen-containing gas into the lower portion of each of said regenerating zones to flow upwardly therethrough in countercurrent contact with the descending solid material and to burn carbonaceous matter from the solid material in the regenerating zones, removing resultant combustion gases from contact with the downwardly moving stream of solid material adjacent the upper portion of each of the regenerating zones, introducing a relatively cool inert fluid into the lower portion of said intermediate zone and into countercurrent contact with the solid material passing through this zone to remove heat of combustion from the downwardly moving solid material in transit from the first to the second regenerating zone, and removing said inert fluid from contact with the downwardly moving stream of solid material adjacent the upper portion of said intermediate zone.

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