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LUBRICATION OF HEAT REGENERATOR PACKING MATERIAL

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No Drawing. Original application November 30, 1949, Serial No. 130,341, now Patent No. 2,671,644, dated March 9, 1954. Divided and this application August 12, 1953, Serial No. 373,904

8 Claims. (Cl. 257—6)

This invention relates to an improved heat regenerator packing material which has been lubricated to reduce dusting.

It has been proposed that stone pellets, within the critical size range of 3/16 inch to 5/8 inch in diameter, may be substituted for the Frankl "aluminum pancake," presently used as a low-temperature heat regenerator packing, without lowering the heat exchange efficiency of the regenerator. Because inexpensive source of supply for such pellets are available, e. g. stone beach pebbles, a great saving in regenerator construction and maintenance cost may be effected.

The Frankl low temperature regenerator or "cold accumulator" and a low temperature gas separation system in which it is used, is described in U. S. Patent 1,890,646 of Mathias Frankl and the improved regenerator packing according to this invention is especially useful for such systems in which a pair of the regenerators effects heat exchange between a compressed gas mixture to be cooled and a cold separation product flowed alternately through each regenerator of the pair.

Such pellet regenerator packing while inexpensive and efficient is subject to a certain amount of "dusting" or powdering in operation. This results from the rapid and reversing fluid flow through the regenerator. Dusting is decreased somewhat by holding the pellets tightly in place with mechanical pressure on the packing material. It increases with increased pressure and velocity of the fluid flow and hence is more troublesome in low-temperature gas separation plants with substantial pressure difference between the inflowing gas mixture and outflowing separation product. Dusting is disadvantageous not only because impurities are introduced into the product but also because in time the pellet size falls below the critical diameter range. The regenerator efficiency then drops and a replacement of the packing material may be necessary.

The principal object of this invention is to provide a pellet regenerator packing material of greatly reduced friability and no material reduction of heat exchange efficiency.

The invention is based on the discovery that dusting may be substantially reduced by coating the pellets with a lubricant. By the term lubricant is meant a liquid or solid lubricant. In heat regenerators used in low-temperature air separation plants the lubricant must also be non-oxidizable and not volatile at the low temperature. Graphite and molybenum disulphide are particularly advantageous solid lubricants for this purpose, as are certain lubricants which are liquid at room temperature, as for example, tricresyl phosphate, silicones such as the liquid polymers of dimethylsilicone, and the liquid polymers of chlorotrifluorethylene. The lubricant coating may be applied in any known manner, for example by rolling the pellets in a drum containing the lubricant. The efficiency of heat regenerator packing material is measured in terms of the fluid pressure drop through the regenerator and the mean temperature difference of the

fluids flowing therethrough. Lubricating the pellet packing material causes only an immaterial increase in the pressure drop and has no effect upon the mean temperature difference. At the same time, it greatly reduces dusting and increases the life of the packing material.

Table I demonstrates the reduction in dusting resulting from a lubricant coating as shown by an 85 hour milling test. It should be noted that a part of the dust in the tests on coated samples was graphite or molybdenum disulphide rather than pellet material.

TABLE I

Effect of lubrication on dusting

Pellet Material	Lubricant	Percent Lubricant	Percent Dusting (uncoated)	Percent Dusting (coated)
¼ inch to ½ inch stone	Graphite	0.05	0.185	0.0094
3/16 inch to 5/8 inch aluminum.	do	[1] 1.26	0.182	0.022
Do	molybdenum disulphide.	[1] 0.45	0.182	0.016
3/16 inch to 5/8 inch cast iron.	do	0.07	0.086	0.010

[1] The aluminum pellets used were in part hollow. This accounts for the excess of lubricant over that consumed in coating the stone and cast iron pellets.

In the art of low temperature air separation, where low temperature heat regenerators or cold accumulators are used to cool the air to be separated by the refrigeration of the outflowing nitrogen and oxygen products, the air enters the system at the substantial pressure of about 75 pounds per square inch while the outflowing products have a pressure very close to atmospheric. During reversal of the flows in the accumulators, the air pressure must be released or blown down before the low pressure product can be passed through a cold accumulator, and also when the air is directed into a cold accumulator that previously was cooled by outflowing product, the air initially enters with a rush until the pressure in the void spaces of the heat storage mass is raised to the higher pressure.

These sudden and severe pressure variations tend to cause movements of the heat storage pellets which result in the dusting problem. The use of stone pellets as the heat storage material in cold accumulators instead of the customary crimped metal pancakes has been found to provide equal efficiency when the size range of the pellets is between three-sixteenths and five-eighths inch, and if the pellets remain within the size range, this efficiency can be maintained even though the air initially contains moisture and carbon dioxide which are separated from the air by deposition on the surfaces of the heat storage material. The treatment of heat storage pellets must not interfere with such air cleaning action in addition to not adversely affecting the heat exchange efficiency.

Lubrication of the pellets according to this invention reduces the dusting of pellets to an extremely negligible amount, and the efficiency of heat exchange can be maintained indefinitely. It was further discovered that the lubrication of the pellets according to the invention not only does not reduce the efficiency of heat exchange and has a negligible effect upon the pressure drop characteristics, but also that such lubrication has no effect on the efficient cleaning of the air of moisture and carbon dioxide.

This application is a division of our copending application Serial No. 130,341 filed November 30, 1949, now U. S. Patent No. 2,671,644.

We claim:

1. A low temperature heat regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with a solid lubricant selected from the group consisting of graphite and molybdenum disulphide.

2. A low temperature heat regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with graphite.

3. A heat regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid through the regenerator, said pellets being each coated with molybdenum disulphide.

4. A low-temperature heat regenerator for effecting heat exchange between a gas mixture to be cooled and a cold separation product flowed alternately therethrough, said regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with a liquid lubricant selected from the group consisting of tricresyl phosphate, normally liquid polymers of dimethylsilicone, and normally liquid polymers of chlorotrifluoroethylene.

5. A low-temperature heat regenerator for effecting heat exchange between a gas mixture to be cooled and a cold separation product flowed alternately therethrough, said regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with tricresyl phosphate.

6. A low-temperature heat regenerator for effecting heat exchange between a gas mixture to be cooled and a cold separation product flowed alternately therethrough, said regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with normally liquid polymers of dimethylsilicone.

7. A low-temperature heat regenerator for effecting heat exchange between a gas mixture to be cooled and a cold separation product flowed alternately therethrough, said regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, said pellets being each coated with normally liquid polymers of chlorotrifluoroethylene.

8. A low temperature heat regenerator containing packing material comprising stone pellets of 3/16 to 5/8 inch diameter, said pellets having a tendency to abrade and dust when subjected to repeated changes of fluid flow through the regenerator, each having a coating selected from the group consisting of graphite and molybdenum disulphide.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,841,368 July 1, 1958

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 23, for "inexpensive source" read --inexpensive sources--; column 3, line 18, after "fluid" insert --flow--.

Signed and sealed this 14th day of October 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

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Commissioner of Patents