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CLEANING OF HEAT EXCHANGERS USED WITH CELLULOSE DIGESTERS

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CLEANING OF HEAT EXCHANGERS USED WITH CELLULOSE DIGESTERS
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This invention relates to the heating of the cooking liquor for cellulose digestion plants and is more particularly concerned with a method and system for cleaning the heating means for the cooking liquor and keeping the same free of scale.

Therefore in the heating of cooking liquor for the cooking of chips in a digester for the production of cellulose pulp the practice has been to use an ordinary indirect heat exchanger with sets of passages isolated from each other by means of heat exchange walls. Thus, the liquor circulating through one set of passages, live steam or other heating medium is circulated through the other set, commonly in countercurrent flow. Accordingly, the cooking liquor drawn from the digester usually from a lower part thereof at the position of a collector ring or strainer, is passed through the heat exchanger, heated and returned to the digester adjacent the upper portion thereof. The cooking liquor, however, tends to form scale, or other residue, on the walls of the heat exchanger passages through which it flows, which scale, if allowed to build up, materially reduces the efficiency of the heat exchanger.

Common methods hereof employed for cleaning the scale from such passages have been either to flush the passages at intervals with special cleaning material designed to remove the scale, or to operate the heat exchanger on a channel switching basis. Channel switching is a reversal arrangement whereby the cooking liquor first flows through one set of the passages in the heat exchanger while live steam, or other heating medium, flows through the other. Then the mediums flowing are interchanged. Preferably this interchange should take place at the end of one cook and ready for the next one. It is not necessarily essential to switch that often, but switching after every few cooks is most desirable. The switching, however, calls for the manipulation of a number of valves to direct the flow of the cooking liquor through the set of passages previously occupied by live steam and to cause steam to flow through the previously liquor occupied passages.

Both of the foregoing methods have drawbacks, however, and are not productive of fully effective results. The straight flushing system calls for the utilization of additional apparatus, the provision of particular cleaning liquid, and, besides adding labor cost, also takes time, so reduces the utilization of the digester, without achieving compensatory satisfactory results. The channel switching system makes it necessary to have additional piping and valves at considerable expense and the switching needs to be performed quite regularly or scale builds up which subsequent switching cannot remove. Both systems are subject to the human factor, that is, unless the workman is sufficiently interested in his job to do the extra work for effecting the cleaning as regularly as he should, the efficiency of the heat exchanger diminishes. Unfortunately, the latter is the rule, rather than the exception.

The method of the invention, by adding little to the steps that the workman has to perform in any event in proceeding towards the blowing of the digester, to a large extent solves the problem introduced by the human element. It also cuts down greatly on additional equipment expense, for only two sections of additional piping and a few valves are necessary in addition to the piping and valves already present for the heating of the cook-

Proceeding to a description of the apparatus, then, it is seen that cooking liquor introduced into the system of the digester 1 and the heat exchanger 3 through some suitable means, such as a charging pipe 4 equipped with a shut-off valve 5, is heated by circulation through the heat exchanger 3. This circulation is achieved by flow of the cooking liquor out of the digestor at the area of the collecting ring or strainer 6 through the pipe 7, by action of the pump 8. The pump 8 pumps the liquor from the pipe 7 up through the pipe 9 into the heat exchanger 3 through its lower end 10, which end serves as a distributor to communicate with and distribute the liquor through one of the set of passages of the flexible plate heat exchanger. Accordingly, the liquor flows upward through one set of passages of the heat exchanger 3, out through the upper end member 11, and into the outlet conduit 12. This conduit 12 has a side conduit 13 connected therewith just outside of the end 11 of the heat exchanger. The conduit or pipe 13, normally of a smaller diameter than that of pipes 7 and 9, extends down almost to the bottom of the conical lower section 14 of the digester, and has a shut-off valve 15 and a check valve 15r in its line. The conduit 13 enters the digester at the position 16 where a strainer 17 on the inside of the digester overlies that entrance. Thus if liquor is flowing up out of the heat exchanger 3 through the conduit 12, a certain portion of it can flow down through the pipe 13 and return into the digester very close to the bottom thereof.

Flow of liquor from the pipe 13r is controlled by a valve 18 which, though normally open during the recirculating heating of the cooking liquor while the cook is going on, can, if desired, be closed to close off any flow into the upper pipe 19 which forms a continuation of the pipe portion 12 above the valve 18. The pipe 19 communicates with the interior of the upper end of the digester at 20. Thus it is apparent that in the normal cooking operation liquor drawn off through the pipe 7 by the pump 8 is pumped upwardly through the heat exchanger 3, being heated in its passage through the heat exchanger, and is redistributed back to the digester, partially through the pipe 13 down to the bottom of the digester and partially up through the pipe 19 into the top of the digester at 20.

The pipe 19 is normally larger than the pipe 13, so more liquor would flow through it unless the valve 18 is adjusted to alter this relationship or to shut off the flow through pipe 19 entirely.

Live steam for heating the cooking liquor is introduced into the alternate set of passages in the heat exchanger 3 through the pipe 21 and under control of the valve 22. This steam passes down through the heat exchanger in contra-current flow with respect to the liquor flowing up and being heated, is condensed in the course of the flow and runs off as condensate through a pipe 23. The pipe 23 may also have a control valve 24 therein at the exit from the heat exchanger.

The system of the invention also includes the normal blow pipe 25 communicating with the bottom of the digester at 26 with the usual blow valve 27 included in it just outside of the digester. The blow pipe 25 discharges at 27 into the upper portion 28 of the blow tank 2.

The two additional piping elements called for in accordance with the system of the invention and for carrying out the method thereof are by-pass pipes 30 and 34. The upper by-pass pipe 30 communicates with the lower blow pipe 9 at the position 31. The pipe 30 has a flushing valve 32 in the line thereof and has its other end in communication with the blow pipe 25 at the position 33 outwardly of the blow valve 27 with respect to the end of the digester. The second by-pass line 34 with a shut-off valve 35 in it forms a communication between pipe 7 and pipe 13. Furthermore, a valve 36 is installed on the pressure side of the pump 8 to be shut off during the flushing period.

During the time the cooking has been going on in the digester 1, cooking liquor will have been circulating through heat exchanger 3, being conducted to the same by the pipe 7, the pump 8 and the pipe 9, and will have been reintroduced back into the digester through the pipe 13 and the pipe 19. This cooking liquor, due to the action of the pump and due to the heating of it under pressure, will be under pressure substantially higher than atmospheric, so that on the opening of the valve 27 the contents of the digester can be blown into the blow tank 2 by that pressure alone. In accordance with the invention, however, as the cook is completed, and just prior to the blowing of the digester, the valve 22 is closed to shut off the steam supply to one set of passages of the heat exchanger 3. Accordingly, the pressure on the steam side in the heat exchanger will go down to zero. Next, the valves 18 and 36 are closed and the valves 33 and 35 which until this point have been closed, are opened. The valve 35 being open and the pump 8 having been stopped, the pressure within the digester will cause liquor to flow under pressure through strainer 6 out the pipe 7, up the pipes 34 and 13, past the junction 12 and down into the liquor passages of the heat exchanger through the head 11. Here, due to the pressure behind this liquor and the absence of steam pressure in the steam passages, the walls of the liquor passages in the heat exchanger will be flexed away from each other. As the liquor picks up velocity rushing through the heat exchanger, it will, besides outwardly expanding or bulging the walls of the passages through which it flows, exert a strong flushing and cleaning action on the walls of the passages. This flushing action is primarily a shock treatment and is not normally expected to take more than a few minutes time. However, if it is found to be of any advantage in any system the flushing may continue during the first part of the blow.

The contra-flow flushing aspect of the invention taken alone, commenced prior to the blowing of the digester, goes a long way towards cleaning the walls of the heat exchanger. Accordingly this novel flushing is highly advantageous if employed in conjunction with flushing in digesters utilizing heat exchangers having rigid, rather than flexible walls for heating the cooking liquor. When, however, the heat exchangers employed are of the flexible wall type there is the additional cleaning factor of the mechanical action of flexing when the pressure in the steam passages drops. This flexing tends to crack or break up and break lose any scale from the wall surface, since the scale will not normally flex the way the wall does. Cracking or any breaking away of scale greatly enhances the effectiveness of the flushing.

It will be clear to those skilled in the art that the example of the method and system of the invention above described are by way of illustration and that useful modifications or variations of the invention as disclosed may be employed without departing from the spirit or scope of that invention.

Having disclosed my invention what I claim as new and desire to secure by Letters Patent is:

1. The method of cleaning the walls bordering the liquor passages of an indirect heat exchanger utilized for the heating of cooking liquor for a digester by causing said liquor to flow in one direction through said passages which comprises, terminating the flow of said liquor in said one direction at substantially the end of a first cooking cycle, then commenced with the introduction of liquor under pressure from said digester and passing such cooking liquor through said liquor passages in reverse direction to the flow of liquor through said passages during the heating of said liquor for cooking.

2. The method as in claim 1 and including blowing
said digester shortly after the commencement of the passage of cooking liquor in reverse direction through said heat exchanger passages.

3. The method as in claim 1 and including, blowing said digester substantially concurrently with the commencement of flow of cooking liquor in said reverse direction in said heat exchanger passages.

4. The method as in claim 1 and causing said walls of said liquor passages to flex by creating a pressure differential between the opposite sides of said walls.

5. The method of cleaning the walls of the liquor passages of an indirect heat exchanger formed with flexible passage walls separating a set of liquor passages from a set of heating medium passages and utilized for the heating of cooking liquor for a digester by causing said liquor to flow in one direction through said liquor passages and by causing a heating medium under pressure to flow through said heating medium passages which comprises, terminating the flow of liquor in said one direction at substantially the end of a cook, withdrawing heated cooking liquor from said digester, passing such withdrawn cooking liquor through said liquor passages in the reverse direction to the flow of liquor through said passages during the heating thereof for cooking and flexing said passage walls away from their normal planes by producing a difference in pressure between said cooking liquor passages and said heating medium passages.

6. The method of cleaning the walls of the liquor passages of an indirect heat exchanger formed with flexible passage walls separating a set of liquor passages from a set of heating medium passages utilized for the heating of cooking liquor for a digester by causing said liquor to flow in one direction through said liquor passages and by causing a heating medium under pressure to flow through said heating medium passages which comprises, terminating the flow of liquor in said one direction at substantially the end of a cook, shutting off the flow of said heating medium to said heating medium passages, withdrawing heated cooking liquor under pressure from said digester, passing such cooking liquor through said liquor passages in reverse direction to the flow of liquor through said passages during the heating thereof for cooking, and expanding said passage walls of said liquor passages outwardly away from each other by the pressure on said withdrawn liquor for facilitating the cleaning of said passage walls.

7. A method as in claim 4 and including, blowing said digester and by-passing said withdrawn liquor around said blow and returning the same to join the remaining contents of said digester in a blow pit.

8. A system for cleaning the walls of liquor passages of heat exchangers utilized with digesters having means for discharging their contents into a blow tank which comprises, a digester, an indirect heat exchanger having liquor passages and heating medium passages, conduit means for circulating liquor from the digester through the liquor passages of the heat exchanger and back to the digester for the heating of such cooking liquor during cooking, means to shut off said circulating means and conduit means connecting said digester and said heat exchanger to pass liquor from said digester through the liquor passages of said heat exchanger in contra-current flow to that of said liquid circulating for heating and means to direct said liquor from said heat exchanger into said blow tank.

9. A system as in claim 8 and including valve means for rendering said directing means for said last named liquor inoperative during said cooking.

10. A system as in claim 8 and said indirect heat exchanger being formed with flexible heat exchanger walls separating the passages thereof.

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