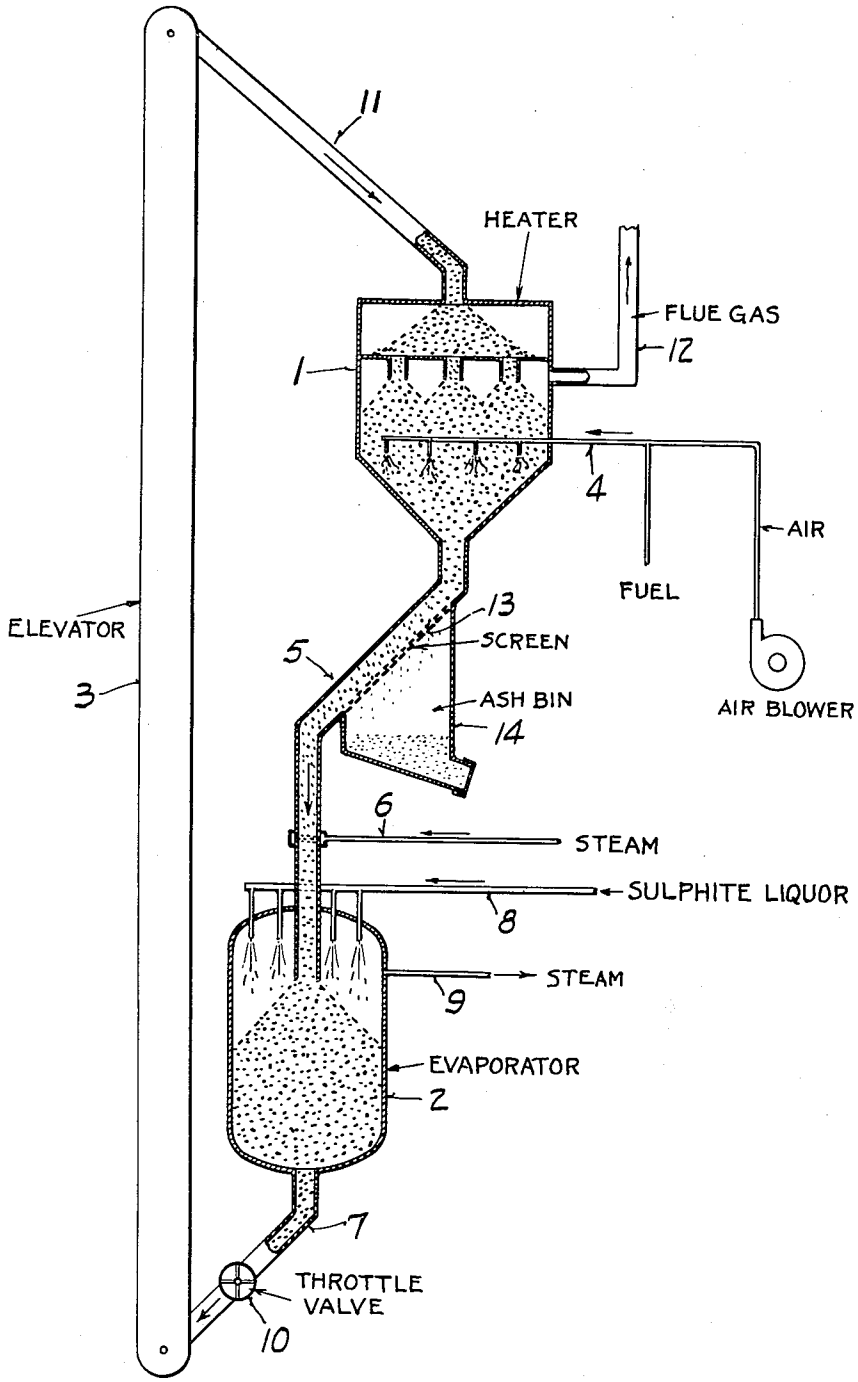
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METHOD AND APPARATUS FOR THE DISPOSAL OF WASTE SULPHITE LIQUOR

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METHOD AND APPARATUS FOR THE DISPOSAL OF WASTE SULPHITE LIQUOR

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The present invention relates to contact evaporation by solid heat transfer material and more particularly to a process for the evaporation and incineration of waste sulphite liquor or other liquids containing combustible material.

Sulphite liquor is a by-product in the production of wood pulp and paper by the so-called sulphite process. This spent liquor contains, in addition to the sulphurous material, lignin and other soluble organic materials representing about fifty per cent of the wood originally employed.

The discharge of this waste sulphite liquor into streams and rivers has resulted in a public nuisance due to the very harmful effect of the liquor on the marine life in the streams. As a result, numerous methods have been devised for the disposal of this liquor and the recovery of the valuable constituents therein. However, all of these disposal processes are expensive and require extensive equipment and as yet have not proven economically practical.

Heretofore the disposal process most frequently employed involved the evaporation of the waste liquor to approximately a 50% concentration in a suitable evaporator, followed by the transfer of the concentrated liquor to a furnace or boiler where it is burned. However, scale formation on the heat transfer surfaces renders the evaporation process very inefficient because of the resultant low heat transfer rate. In addition, the burning of the concentrated liquor has presented serious problems in boiler tube maintenance and in release of fly ash.

The present invention is directed to a novel process for the disposal of sulphite liquor whereby the waste liquor is preferably evaporated to dryness, and the combustible portions of the evaporated liquor burned, in a continuous process. By this invention the difficulties due to scale formation are eliminated, for heat transfer in the evaporator is accomplished by bringing the sulphite liquor into contact with a continuously circulating mass of granular or pebbled heat transfer material which has been heated in a heater and is introduced into the evaporator as a continuous stream. The liquor is evaporated on contact with the heated pebbles with the residue of evaporation tending to adhere to the surface of the pebbles. The pebbles are recirculated to the heater where the combustible portion of the residue is burned from the surface of the pebbles, thus reheating the pebbles in preparation for the recycling thereof.

An object of the present invention is to provide an inexpensive and rapid process for the disposal of sulphite liquor whereby the evaporation and incineration of the liquor may be accomplished in one continuous operation.

Another object is to provide a method of evaporating waste sulphite liquor substantially to dryness by bringing the liquor into contact with a continuously moving mass of heated granular or pebbled solids.

Still another object is to provide a contact process

for the evaporation and burning of liquids containing combustible matter whereby the evaporated liquid is burned to supply heat to contacting solids or pebbles during regeneration.

Other objects and advantages of the present invention will appear in the course of the following description.

In the drawing, the figure is a diagrammatic representation of the apparatus for the process to which the invention is directed.

Referring to the drawing, a solid heat transfer material, which may be any granular or pebbled refractory substance, is circulated in a closed cycle including a heater 1, an evaporator 2, and an elevator 3.

To start the cycle the heat transfer granules or pebbles are heated in the heater 1 by any suitable means. As shown in the drawing the solids are heated by the combustion of a mixture of fuel gas and air which is introduced into the heater through line 4.

If the present invention is to be employed in the disposal of sulphite liquor produced as a by-product in the wood pulp or paper industry, it may be preferred to employ wood chips or shavings as fuel to heat the pebbles.

The highly heated pebbles pass through a feed leg 5 to the evaporator 2.

The temperature of the pebbles entering the evaporator may be in the neighborhood of 1500 to 2000° F. However this temperature may vary within a broad range with the desired temperature depending on the rate of flow of the liquor entering the evaporator and the rate of flow of the pebbles being introduced into the evaporator.

A small amount of steam may be introduced into feed leg 5 by line 6 to control the temperature of the pebbles entering the evaporator 2 and to prevent flow of gases or vapors between heater 1 and evaporator 2.

In the evaporator the pebbles take the form of a downwardly moving mass with heated pebbles continually being added to the top of the bed and the cooled pebbles being continuously withdrawn from the bottom of the bed through feed chute 7 in the lower portion of evaporator 2.

The sulphite liquor is introduced into the evaporator 2 by line 8 and may be sprayed, jetted through nozzles or cascaded over weirs onto the top of the moving mass of pebbles. The sulphite liquor, as introduced, is normally a dilute by-product of the sulphite pulp making process containing approximately 10% of dissolved solids. However, concentrated liquor may be introduced as feed if desired, and the process of the present invention may be utilized to further concentrate and incinerate liquor having a concentration of over 50% solids which cannot be effectively or economically evaporated by other evaporation systems. In addition to sulphurous constituents the dissolved solids consist of lignin, resins, and other combustible organic matter representing about 50% of the wood originally employed in the sulphite process.

The sulphite liquor is evaporated on contacting the heated granules and the low pressure steam produced during the evaporation operation leaves the evaporator by line 9.

The temperature of the granules in the evaporator should preferably be maintained below the temperature of decomposition of the organic material in the liquor, so that the material will not decompose and be driven off in the evaporation process with a resulting contamination of the steam. The steam produced may nevertheless tend to be somewhat corrosive due to the presence of sulfur compounds and may be limited in application to process heating.

However the steam, whether corrosive or not, may be employed to strip sulfur dioxide from the sulphite liquor

before the liquor is introduced into the evaporator. By this operation a recovery of the essential sulphur dioxide is attained and the steam produced by the evaporation of the stripped liquor will be correspondingly less corrosive.

Any degree of evaporation may be attained in the evaporator by preferably controlling the temperature and rate of flow of the entering granules or by controlling the rate of flow of the entering liquor.

As a sulphite liquor having a concentration of greater than 50% solids will generally burn without the addition of outside fuel, it is essential that the liquor be evaporated at least to such a concentration. However, it may be most desirable to evaporate to complete dryness in order to subsequently obtain the most efficient heating of the heat transfer pebbles in the heating section **1**.

The temperature of the pebbles leaving the evaporator at chute **7** should be just slightly above the evaporating temperature of the liquor in order to obtain the maximum evaporating effect from each pebble, thereby reducing the amount of pebbles to be circulated in obtaining a given degree of evaporation. Further, a low evaporator exit temperature considerably simplifies the problems involved in design and maintenance of throttle valve **10** in chute **7** and of elevator **3** which returns the pebbles to the heater **1** in that special heat resistant alloys are not required for the throttle valve and the elevator.

As the sulphite liquor is evaporated, the residue of evaporation, consisting of the sulphurous and organic compounds, tends to deposit on the surface of the refractory pebbles. The coated pebbles and any evaporation residue which has not adhered to the pebbles, move downwardly through the evaporator and are discharged therefrom through feed chute **7** and throttle valve **10** to elevator **3**. The throttle valve **10** controls the rate of flow of the pebbles through the system.

The elevator **3** is employed to lift the pebbles and the evaporation residue to heating chamber **1** and may comprise any convenient means such as a bucket lift or air lift.

From the top of the elevator **3** the coated pebbles and free residue flow downwardly through feed chute **11** to heater **1** where the free residue and the residual deposit on the pebbles are burned to pre-heat or partially pre-heat the pebbles. Additional fuel may be introduced into the heater as hereinbefore described to further heat the pebbles to the desired re-cycling temperature. The resulting combustion gases leave the heater through flue **12**.

During the heating, the pebbles in the heater **1** are in the form of a downwardly moving mass, and by the time the pebbles reach the bottom of the heater the coating has been burned from the pebbles and the pebbles are heated sufficiently to enter the evaporator **2**.

To reduce the heat loss in the heater through the flue gases, it may be desirable to operate the heater at a temperature just above the lowest temperature at which the combustibles will ignite. This relatively low operating temperature in the heater will simplify design problems and reduce the cost of that part of the unit. However, the low operating temperature in the heater results in the pebbles having a lower temperature as they enter the evaporator, and hence decreases the evaporating effect of each pebble. Thus a greater volume of low temperature pebbles will have to be circulated through the system to produce the equivalent evaporating effect obtained by higher temperature pebbles. Therefore, it is necessary to balance these factors, with the operating temperature of the heater being dependent upon the economics of manufacture.

As a considerable amount of ash is produced by the combustion of the evaporation residue in the heater **1** and as there is some noncombustible residue, a means may be provided in the system for the removal of the ash and noncombustible residue.

The ash and noncombustible residue are readily separable from the heat transfer pebbles, and separation may be accomplished by setting feed leg **5** at an angle to the heater **1** and inserting a screen or perforated separator **13** into the portion of the feed leg that faces downward. As the heated pebbles, ash and noncombustible residue pass downwardly through the leg, the ash and residue will fall through screen **13** into ash bin **14**, and the pebbles, being too large to pass through screen **13**, will continue to evaporator **2**. Any ash or residue not removed from the system merely serves as additional heat transfer material.

The present invention utilizes the combustible products in sulphite waste liquor to provide approximately 60 to 70% of the heat theoretically required to evaporate the liquor to dryness. By utilizing the flue gases and the steam generated in the evaporator for process heating, the process may tend to approach an overall thermal equilibrium whereby the heat generated by the additional fuel added in the heater is balanced by the heat recovered from the flue gases and from the generated steam.

The present invention may be applied to the evaporation of any liquid and is particularly adapted for use in the evaporation of liquids containing solid matter, whereby the evaporation solids or residue may be recovered as such, or the combustible portion of the residue may be utilized to pre-heat the refractory pebbles.

Although the present invention has been described as a continuous process of evaporation and incineration, it is contemplated that a batch process may also be employed for smaller quantities of liquor, whereby a charge of liquor is introduced onto a stationary bed of heated pebbles and evaporated, with the evaporation residue being burned in the same confined zone to re-heat the pebbles.

Various practices and embodiments of the invention may be employed within the scope of the following claims.

I claim:

1. A process for the continuous evaporation and incineration of waste sulphite liquor comprising, preheating a divided solid heat transfer material in a confined burning zone to a temperature above that required to evaporate the liquor, passing the divided solid heat transfer material through a confined evaporating zone as a moving mass, introducing said liquor into said evaporating zone into contact with the heat transfer material to evaporate said liquor with a portion of the evaporation residue being deposited on said heat transfer material, withdrawing the vaporous products of evaporation from said evaporating zone, separately withdrawing the heat transfer material and the evaporation residue from said evaporating zone with the temperature of said withdrawn material being maintained slightly above the evaporation temperature of said liquor to obtain the maximum evaporating effect from said material, transferring said material and said residue to the burning zone, passing the heat transfer material through said burning zone as a moving mass and passing fuel and oxygen to the material in the burning zone and igniting the same with the combustible portion of the evaporation residue being burned in contact with said material to raise the temperature of said material, withdrawing the combustion gases from said burning zone, and returning the substantially residue free material again to the evaporation zone to restart the process cycle.

2. A process for the continuous evaporation and incineration of sulphite liquor comprising, preheating a divided solid heat transfer material to a temperature above the temperature required to evaporate the liquor, passing the heated divided solid heat transfer material through a confined evaporating zone as a downwardly moving mass, introducing the liquor into said evaporating zone into contact with the moving mass of heat transfer material to evaporate said liquor, withdrawing the vaporous products of evaporation from the top of said evaporating zone, separately withdrawing the heat transfer material together with evaporation residue from the bottom of said evaporating zone, transferring said material and said

residue to a confined burning zone, passing said material and said residue through said burning zone as a moving mass introducing a combustion supporting medium into the burning zone and igniting the combustible portion of the residue to thereby raise the temperature of said material, withdrawing the combustion gases from said burning zone, and returning the substantially residue free material again to the evaporation zone to restart the process cycle.

3. A process for the continuous evaporation and incineration of liquids containing combustible material, comprising, preheating a divided solid heat transfer material to a temperature above the temperature required for the evaporation of the liquor, passing the divided solid heat transfer material through a confined evaporating zone as a moving mass, introducing said liquor into said evaporating zone into contact with the heat transfer material, withdrawing the vaporous products of evaporation from said evaporating zone, transferring the heat transfer material and the residue of evaporation to a confined burning zone, passing fuel and oxygen to the material in the burning zone and igniting the fuel to burn the combustible portion of said residue in contact with the heat transfer material and simultaneously raise the temperature of said material, withdrawing the combustion gases from said burning zone, separately removing the noncombustible residue and the ash produced by the burning from said burning zone, and returning the substantially residue free material again to the evaporation zone to restart the process cycle.

4. A process for the continuous evaporation and incineration of liquids containing combustible material comprising, preheating a divided solid heat transfer material in a confined burning zone to a temperature above the temperature required to evaporate the liquid, passing the solid heat transfer material from the burning zone through a confined evaporating zone as a heated moving mass, introducing said liquor into said evaporating zone into contact with the heat transfer material to evaporate said liquor substantially to dryness, withdrawing the resulting vaporous products from said evaporating zone, transferring the heat transfer material and the residue of evaporation to the burning zone, introducing fuel and a combustion supporting medium to the material in the burning zone and igniting the fuel to burn the combustible portion of said residue in contact with the heat transfer material and simultaneously raise the temperature of said material, withdrawing the combustion gases from said burning zone, separating the noncombustible residue and ash produced by the burning of said residue from the heat transfer material, and returning the substantially residue free material again to the evaporation zone to restart the process cycle.

5. A process for the continuous evaporation and incineration of waste sulphite liquor comprising, preheating a granular solid heat transfer material in a confined burning zone to a temperature above the evaporation temperature of the liquor by introducing fuel and oxygen into said burning zone and igniting the same, passing the granular solid heat transfer material from the burning zone through a confined evaporating zone as a continuously moving mass, controlling the temperature of the heat transfer material entering the evaporating zone by passing steam through said material before said material is introduced into said evaporating zone, introducing said liquor into said evaporating zone into contact with the heat transfer material to evaporate said liquor with a portion of the evaporation residue being deposited on the surface of said heat transfer material, withdrawing the vaporous products of evaporation from said evaporating zone, separately withdrawing the heat transfer material containing the deposited residue together with undeposited residue from said evaporating zone, transferring said material and said residue to the burning zone, passing fuel and oxygen to the material in the burning zone and igniting the same to burn said residue in said burning zone and raise the temperature of said material, withdrawing the combustion gases from said burning zone, and returning the substantially residue free material again to the evaporation zone to restart the process cycle.

6. A closed cycle apparatus for the evaporation and incineration of waste sulphite liquor comprising, an evaporator having an inlet and an outlet for the entry and discharge respectively of a solid transfer material and having a second inlet for the introduction of the sulphite liquor, said liquor adapted to be introduced into contact with a heated mass of divided solid heat transfer material to evaporate said liquor with the residue of evaporation having a concentration of at least 50% solids, a heater disposed above the evaporator for burning said residue in contact with the heat transfer material to raise the temperature of said material, means communicating with said heater for introducing additional fuel and a combustion supporting medium to the heater with said fuel being burned in said heater in contact with the heat transfer material to further raise the temperature of said material, elevator means connecting the outlet of said evaporator to the upper portion of said heater to convey the heat transfer material and the residue of evaporation from the evaporator to the heater, a feed leg connecting the lower portion of said heater to said first named inlet of said evaporator to conduct the heat transfer material and the uncombustible portion of said residue from the heater to the evaporator, and means for separating the uncombustible portion of said residue from the heat transfer material prior to the introduction of said material into the evaporator.

7. An apparatus for the evaporation and incineration of liquids containing combustible solid matter comprising an evaporation chamber wherein the liquid is adapted to be evaporated by contact with a divided solid heat transfer material with said material being at a temperature substantially above the temperature required for the evaporation of said liquid, conveying means for introducing said heat transfer material into said chamber, means for introducing said liquid into said chamber, means associated with said conveying means for controlling the temperature of the material entering said evaporation chamber, and means for burning the combustible portion of the residue of evaporation to re-heat the heat transfer material.

8. In a process for the evaporation and incineration of liquids containing solid combustible matter, the steps comprising, preheating a bed of solid heat transfer material to a temperature substantially above the temperature required for the evaporation of the liquid, contacting the liquid by the bed of solid heat transfer material in an evaporation zone to evaporate the liquid and deposit the residue products of evaporation on said material, withdrawing the material from the evaporation zone, heating the material by passing oxygen to the material in a burning zone and igniting the combustible matter of the residue to burn the residue from the material and simultaneously heat said material to the temperature required for evaporation of additional liquid, and then returning the heated and generally clean heat transfer material into contact with the additional liquid that is supplied for evaporation and incineration.

9. In a process for the continuous evaporation and incineration of waste sulphite liquor, the steps comprising heating a divided solid heat transfer material in a confined burning zone to a temperature substantially above the temperature required for the evaporation of the liquor by introducing fuel and oxygen into said burning zone and igniting the same, passing the divided solid heat transfer material from the burning zone through a confined evaporating zone, introducing the liquor into said evaporating zone into contact with the material to evaporate said liquor with a substantial portion of the evaporation residue being deposited on the surface of the material, withdrawing the vaporous products of evaporation from said evaporating zone, separately withdrawing the heat transfer material containing the deposited residue to-

gether with any undeposited residue from said evaporating zone, transferring said residue coated material and the undeposited residue to a burning and heating zone, passing said material through the burning and heating zone as a moving mass and passing fuel and oxygen to the material in the burning and heating zone and igniting the same to burn the combustible portion of the residue on the material together with the undeposited residue to thereby remove the residue from the material and simultaneously raise the temperature of said material above that required to evaporate said liquor, withdrawing the combustion gases from the burning and heating zone, and

returning the substantially residue free material again to the evaporation zone to restart the process cycle.

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