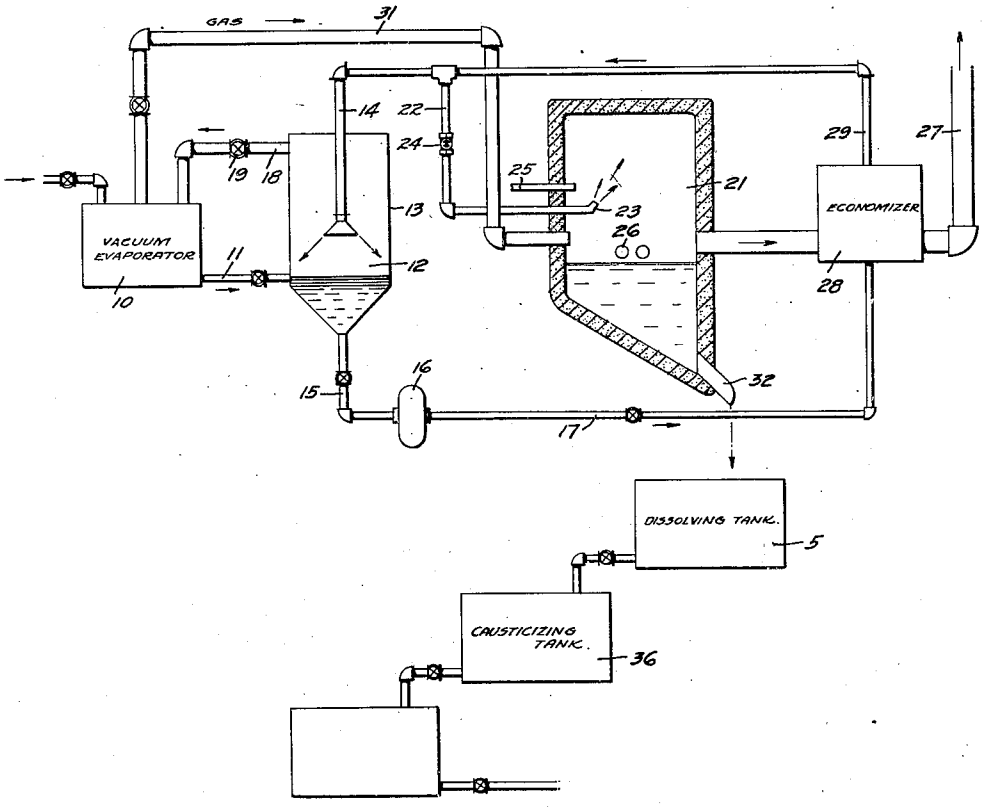
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SYSTEM AND PROCESS OF TREATING WASTE LIQUORS

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SYSTEM AND PROCESS OF TREATING WASTE LIQUORS

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This invention relates generally to the manufacture of wood pulp and is primarily concerned with the recovery of chemicals from so-called digester liquor. This liquor is removed from the digesters in which the wood is cooked and from the washers during the process of manufacturing wood pulp by the soda and sulphate processes.

Waste liquors from the manufacture of soda and sulphate pulp are commonly treated by a process of concentration and smelting for the recovery of the soda which may be used again in the digesters. Various systems and processes have been designed for this purpose, the most common of which dehydrate the liquors to high concentrations by the use of rotary incinerators or disc dryers used separately or in conjunction with vacuum evaporators, after which the resulting substance is smelted in a furnace. This method is unsatisfactory in that it is slow and inefficient in operation, and expensive to install and maintain. Another serious objection to this system is that offensive odors are discharged, thus rendering such an installation a nuisance to the surrounding country and a detriment to the health and comfort of the workmen.

To minimize the odors and expense incident to the older system, it has been proposed to dispense with the disk and rotary driers and burn the liquor at about 40 to 50% solids direct from the vacuum evaporators. Such systems necessarily require a special type of furnace for spraying the liquor into a combustion chamber at high pressures and temperatures, either with or without simultaneous injection of other fuel. Since the liquor contains carbonaceous matter, no extra fuel is required for its burning providing sufficient pressure and preheating are employed. Systems of the latter type, while an improvement over the earlier systems, are still inefficient and unsatisfactory because of the preheating required, the relatively large special furnace necessary to complete the evaporation and smelt the chemicals, and the incomplete elimination of objectionable odors.

The inefficient operation which has characterized prior systems has made it previously impossible to utilize all of the effluent liquors from the pulp washes. As a result streams in the neighborhood of pulp mills have been polluted with the discharge of such liquors.

This invention has for one of its objects the devising of a system and process for the recovery of chemicals from digester liquors which will entirely obviate the discharge of objectionable odors.

It is a further object of this invention to device a system such as described above which will have the advantage of being cheap to install and to maintain in operating condition.

It is a further object of this invention to devise a system of this character which will have high thermal efficiency and will require no other source of heat than that produced by the burning of the combustible material in the liquor.

It is a further object of this invention to devise a system which will be sufficiently economical in operation to make practical the use of all wash liquors for the recovery of chemicals, thus making stream pollution unnecessary.

It is a further object of this invention to effect the dehydration of the digester liquors in an efficient closed apparatus to very high concentration, thereby making possible the burning of concentrated liquor in a furnace as a comparatively dry feed as contrasted with systems which employ furnaces operating on wet feed. Thus the gaseous products of combustion in the furnace are caused to have minimum water vapor content and therefore are in best condition for the recovery of contained heat.

It is to be understood that the invention is capable of many modifications within the scope of the appended claims which are to be accorded a range of equivalents consistent with the prior art.

The system of this invention in its preferred form incorporates an evaporator for initially treating the liquor, a dehydrator, and a smelting furnace for burning the highly concentrated liquor received from the dehydrator. By maintaining a proper thermal

balance the entire system is operated from heat produced by the burning of the liquor and additional heat may even be available for use outside the system.

Thus referring to the single diagrammatic illustration, the system employs an evaporator 10 which is adapted to receive dilute liquor from the pulp digesters or washers. This evaporator is preferably of the multi-effect vacuum type which will efficiently concentrate the liquor to about 50% solids beyond which concentration the liquor becomes too viscous for further treatment in such apparatus. From the evaporator the liquor is conveyed through pipe 11 to the dehydrator designated generally at 12. This dehydrator comprises an expansion chamber 13 through which heated liquor is repeatedly circulated until concentrated to the desired degree. Thus liquor in the bottom of the chamber 13 is withdrawn through pipe 15 by means of pump 16 and passed through pipe 17 and a suitable heater after which it is sprayed into the chamber through pipe 14. The mixture of steam and gas discharged through pipe 18 is controlled by suitable means such as a valve 19 so as to maintain a suitable pressure in the chamber 13. In practice this pressure is such that the liquor collected in the bottom of the chamber 13 may be maintained at a temperature which will render it free flowing.

The highly concentrated liquor from the dehydrator may be withdrawn at any convenient point and conveyed to a smelting furnace 21. Preferably the liquor is fed into the furnace at a relatively high temperature so that it will readily ignite and burn of its own accord. Liquor of this kind contains sufficient carbonaceous content to more than support its own combustion. For convenience the concentrate may be discharged from the dehydrator into a storage tank and thence into the furnace, or if the dehydrator is operated continuously it may be discharged directly into the furnace. Thus there has been shown a pipe connection 22 communicating between pipe 29 and a spray pipe 23 located within the furnace. For controlling the flow of liquor into the furnace, suitable means such as the valve 24 may be provided. In order to furnish air to support the combustion the furnace has been shown as provided with tuyères 26. Salt cake or sodium sulfate (Na_2SO_4) is also introduced into the furnace simultaneously with the liquor as by ejector pipe 25 or other suitable means, for a purpose later to be described.

In order to secure economy of operation the heat of the flue gases from the furnace is employed to heat the liquor being circulated in the dehydrator. Thus, the furnace is connected to a suitable draft appliance such as the stack 27 and inserted between the stack and the furnace there is a suitable heat exchange device such as an economizer 28. This economizer receives liquor from the pump 16 and pipe 17 and discharges the same at a higher temperature through pipe 29 to the spray pipe 14.

The gas evolved in the expansion chamber 13 contains odors which would be offensive if permitted to escape into the air. Furthermore, the steam discharged with the gas contains considerable heat which it is proposed to recover within the system. Thus the pipe 18 through which the mixture of gas and steam discharges from the expansion chamber 13, is connected to the evaporator 10 where it imparts the greater portion of its heat to the liquor being introduced into the system. The steam is then condensed and the remaining gas is taken off through pipe 31 and introduced into the furnace 21 in a zone of high temperature.

While it is appreciated that deodorization of gas by burning is not new, in this particular case complete deodorization is accomplished by utilizing the particular type of dehydrator described in which the gases are evolved in a closed system and are unmixed with air or other non-condensable gases. These undiluted gases are readily and completely disposed of in the high temperature zone of the furnace so that the flue gases from the furnace are free from objectionable odors. In other systems in which comparatively high water content liquor is burned within a furnace it is necessary to first drive off or vaporize the large remaining water content before combustion of the carbonaceous material may occur. The large amount of heat necessary for this vaporization lowers the operating temperature of the furnace to the point where even if gases evolved from the liquor in the evaporator were introduced into the furnace, complete breakdown of the complex gaseous compounds would not occur and objectionable odors would be discharged from the furnace. In my system, since the feed is relatively dry, a sufficiently high furnace temperature to completely break down these compounds may be readily maintained. With the particular form of furnace shown it has been found that a smelting temperature cannot be satisfactorily maintained when using feed containing say 50% water. However, with the dry or highly concentrated liquor such as I propose to use, smelting temperatures are reached without difficulty and a zone of high temperature is maintained at the lower portion of the combustion chamber where the gases from the dehydrator are introduced.

In operating the system as described above, dilute liquor is introduced into the evaporator 10 where water is removed until the concentration has reached about 40 to 50% solids. Further evaporation by the vacuum evaporator is impossible as the liquor becomes too viscous for ebullition. The liquor is then dis-

charged into the dehydrator whereby circulation through the chamber 13 it is caused to evolve gas and steam until its concentration has reached the neighborhood of 90% solids after which it is discharged into and burned in the furnace 21, together with the sodium sulfate. The smelted content collects at the bottom of the furnace and is withdrawn through trough 32. Flue gases from the furnace impart heat to the economizer 28 thereby heating the liquor being circulated through the dehydrator. The gas and steam discharged from the expansion chamber 13 are utilized to heat the evaporator 10 and the gases are then deodorized by burning in the furnace 21. Preferably this process is made continuous, that is, the concentrate is continuously introduced and the smelted material continually removed from the furnace. However, it is possible by manual manipulation of the valves provided to operate the system by taking successive charges of liquor. When operating in this manner a suitable storage tank is interposed between the dehydrator and spray pipe 23.

In most instances it will be found that the burning of the liquor produces more than enough heat for operating the entire system. The excess heat may be recovered in a number of different ways, as for example by inserting a waste heat boiler or economizer in the furnace stack. Generally however, it is more desirable to use more of the wash liquor in the recovery process to establish a thermal balance. In the prior systems, because of economic considerations, it has been customary to treat the digester liquors and only a portion of the more dilute wash liquors and to discharge the remainder in nearby streams. However, in the system of this invention because of the higher inherent efficiency, it is possible to use all of the wash liquors, thus not only effecting a more complete recovery of the chemicals used in the pulp manufacture but also obviating the necessity of stream pollution.

The chemistry of the complete process for the recovery of chemicals from the digester liquor need only be briefly reviewed as it is well known in the art. The concentrated liquor when smelted with sodium sulfate (Na_2SO_4) produces a mixture of sodium carbonate and sodium sulphide which is permitted to drain into a dissolving tank 5 where it is dissolved in water. From the dissolving tank it is conveyed to a cauticizing tank 36 where the sodium carbonate content is caused to react with calcium hydroxide ($Ca(OH)_2$), thereby producing the desired sodium hydroxide (NaOH).

Because of the high concentration of the liquor burned in the furnace, the combustion is easy to start and maintain and is thermally efficient. The simplicity of the dehydrator precludes frequent shut downs and repairs in addition to making possible the complete absence of objectionable odors. The entire system is also balanced so that it may be controlled at any one of a number of points. For example, by admitting more liquor to the furnace the increased heat goes back into the system to accelerate operation of the evaporator and dehydrator.

It is obvious that the system is susceptible of many modifications within the spirit of the invention. For example, instead of employing an economizer 28, a waste heat boiler may be inserted in the stack and steam from this boiler employed to heat liquor being circulated in the dehydrator.

I claim:

1. In a system for the recovery of chemicals from waste liquor, the combination of a dehydrator for concentrating the liquor, a furnace for smelting the concentrate, an economizer receiving heat from said combustion, and means for heating the liquor in the dehydrator by said economizer.

2. In a system for the recovery of chemicals from waste liquor, the combination of a dehydrator comprising an expansion chamber thru which the liquor is continuously circulated, said chamber having an outlet for removal of vapors from the same, a furnace for smelting concentrate received from the dehydrator, and means for causing heat from the furnace to heat liquor being circulated thru the dehydrator chamber.

3. In a system for the recovery of chemicals from waste liquor, the combination of a dehydrator for concentrating liquor comprising an expansion chamber thru which the liquor is adapted to continuously circulate, a furnace for smelting the concentrated material received from the dehydrator, means for causing the heat from the furnace to heat liquor being circulated thru the dehydrator, and means for introducing gas evolved from the chamber into the furnace to deodorize the same.

4. In a system for the recovery of chemicals from waste liquor, the combination of a dehydrator comprising an expansion chamber thru which heated liquor is continuously circulated, an evaporator for partially concentrating the liquor before introduction into the dehydrator, and means for heating said evaporator from the vaporous products evolved from said dehydrator.

5. In a system for the recovery of chemicals from waste liquor, the combination of an evaporator, a dehydrator comprising an expansion chamber thru which heated liquor is adapted to circulate, a furnace for smelting the concentrated material from the dehydrator, means for passing vapors evolved from the dehydrator thru the evaporator, and means for introducing the gas evolved from the evaporator into the furnace.

6. In a system for the recovery of chem-

icals from waste liquor, the combination of an evaporator, a dehydrator for receiving liquor from the evaporator, the dehydrator comprising an expansion chamber thru which heated liquor is continuously circulated, a furnace for burning concentrated material obtained from the dehydrator, means for receiving heat from the furnace for heating liquor circulated thru the chamber, means for passing vaporous products from the dehydrator thru the evaporator, and means for introducing the resulting gas into the furnace.

7. A process for the recovery of chemicals from waste liquor characterized by the use of a dehydrator and a smelting furnace, said process comprising effecting high concentration of the liquor in the dehydrator, sustaining the temperature of the furnace by the combustion of material concentrated by the dehydrator, and passing gases evolved from the dehydrator thru a high temperature zone of the furnace.

8. A process for the recovery of chemical from waste liquor comprising dehydrating the liquor to a high concentration by continuously circulating the heated liquor thru a closed expansion chamber while simultaneously continually removing evolved vapors from said chamber, and burning said concentrated liquor in a furnace together with gases evolved from said chamber.

9. A process for the recovery of chemical from waste liquor comprising dehydrating the liquor to a high concentration by repeatedly circulating the heated liquor thru a closed expansion chamber while simultaneously continually removing evolved vapors from said chamber, and smelting the concentrated material in a furnace, the combustible constituents of the material forming the sole source of heat for said furnace.

10. A process for the recovery of chemicals from waste liquor characterized by the use of an expansion chamber, said method comprising continuously removing liquor from said chamber and reintroducing the same back into the chamber, supplying heat to the liquor removed from the chamber before reintroducing the same, and effecting removal of the evolved vapors from the chamber at a rate which will maintain the liquor within the chamber free flowing, and effecting a recovery of chemical from the material thereby concentrated.

In testimony whereof, I have hereunto set my hand.

DAVID D. PEEBLES.