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PROCESS FOR TREATING ALKALINE LIQUORS

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Our invention relates to an improved process for the treatment of any alkaline liquor containing organic matter, whereby the alkalinity of the liquor is eliminated and a substantial portion of the organic matter removed therefrom, the object being to provide an inexpensive and effective method of accomplishing these results.

Our improved process involves treatment of the alkaline liquor with a gas containing carbon dioxide in such a manner as to form carbonates with the alkaline substances present but no bicarbonates of these substances, admixing the proper amount of calcium chloride, and finally the separation of the precipitated solids from the liquor.

Our improved process is particularly useful in the treatment of alkaline factory-waste liquors preparatory to their disposal, and as an example of its practical utility we shall describe the application of our improved method in the treatment of a factory-waste liquor known as "kier liquor," but we would have it understood that we do not limit ourselves to this particular application of our invention.

In the cleaning of cotton cloth (or cotton linters) the common method consists in boiling the cotton cloth for a considerable time in a solution of caustic soda. The boiling operation is carried on in containers known as "kiers" and the resulting brown or black caustic liquor is known as "kier liquor." The disposal of this kier liquor presents a serious problem in the textile industry. By our improved method something more than 75% of the color and a substantial portion of the organic matter is removed from the liquor in a single treatment, while at the same time the liquor is rendered neutral in its character. The manner of operating our improved process in its application to kier liquor is as follows:

The kier liquor, as drawn from the kiers, is temporarily stored in suitable tanks, from which it is pumped in any convenient manner in a steady stream to the top of an absorption tower of proper design and is then allowed to trickle down over the packing in the tower. Flue gas, or any other gas containing carbon dioxide, is simultaneously passed upward through the tower in a counter-current flow to the descending kier liquor, with the result that the carbon dioxide content of the gas reacts chemically upon the caustic content of the kier liquor and converts the free caustic soda therein into a mixture of sodium carbonate and sodium bicarbonate, the proportions of these compounds depending upon the temperature, duration of contact, the several concentrations, and other factors. For the purposes of our process, the relative proportion of sodium carbonate and sodium bicarbonate resulting is immaterial, but there must always be sufficient carbon dioxide absorbed from the gas by the kier liquor to at least convert the free caustic in the kier liquor to a carbonate. The two principal chemical reactions occurring as the result of subjecting the kier liquor to the gas would be represented in the following manner:

$$2NaOH+CO_2=Na_2CO_3+H_2O$$
$$Na_2CO_3+CO_2+H_2O=2NaHCO_3$$

To the treated liquor issuing from the foot of the absorption tower we now add either continuously or batchwise, such a proportion of untreated kier liquor as will give a mixture containing neither free caustic nor bicarbonate. The plant chemist employed for conducting the process will have no difficulty in determining from tests on the treated and untreated kier liquors the proportions in which they should be mixed in order to secure the above described result, namely, a mixture containing neither free caustic nor bicarbonate. The chief chemical reaction occurring when the treated and untreated kier liquors are mixed may be represented as follows:

$$NaHCO_3+NaOH=Na_2CO_3+H_2O$$

If it should happen that just enough carbon dioxide is initially absorbed in the tower from the gas to convert the free caustic in the untreated kier liquor into carbonate but none into bicarbonate, then no subsequent addition of untreated kier liquor into the

treated kier liquor as above suggested would be necessary.

We have, however, found that in the practical prosecution of our improved process, it is better to provide for the absorption of more carbon dioxide than is required to convert the free caustic in the kier liquor into carbonate and then eliminate the bicarbonate by adding untreated kier liquor, as above specified, though, as specified, it is quite possible to carry on the process in such a manner that only carbonate will be formed.

Having now secured a treated kier liquor which is essentially free from both free caustic and bicarbonate, we add in either a continuous or batchwise manner, such a proportion of calcium chloride as is a little more than chemically equivalent to the total sodium compounds present in the kier liquor involved in the treatment. This proportion may be readily determined by suitable tests available to the plant chemist. The principal reactions occuring on the addition of calcium chloride to the treated liquor may be represented as follows:

$$Na_2CO_3 + CaCl_2 = 2NaCl + CaCO_3$$
$$2NaX + CaCl_2 = 2NaCl + CaX_2$$
$$Na_2X + CaCl_2 = 2NaCl + CaX$$

In the above formulæ the symbol "X" denotes all of those organic acid radicals which, on uniting with calcium, form a relatively insoluble calcium compound. For example, if a sodium soap, such as sodium oleate, were present, then insoluble calcium oleate would form and be precipitated along with the calcium carbonate.

Having added the requisite proportion of calcium chloride, as above specified, the liquor is now run out into a settling basin. We have found that the precipitate formed on adding calcium chloride settles rapidly, carrying down more than three-fourths of the color present. The effluent from the settling basin may be run directly into the running stream as waste liquor or given further treatment to remove remaining color, if desired.

There are several alternate methods of carrying out our process without departing from the principle thereof. Thus, some other method than the use of an absorption tower may be resorted to for subjecting the kier liquor to the action of a gas containing carbon dioxide, that method being common and well understood and efficient, but not essential.

If desired, the calcium chloride may be added to the kier liquor before the latter is treated to the action of a flue gas or other gas containing carbon dioxide. Also, the absorption tower, or whatever may be designed to take its place, may be operated and controlled in such a manner that only carbonate and no bicarbonate is formed in the waste liquor; or the liquor from the tower may be boiled or aerated so as to remove the excess carbon dioxide over and beyond that required to form only carbonate.

While we have described our process as it applies to the treatment of kier liquor, it is equally applicable to the treatment of any factory-waste products containing free caustic, carbonate, bicarbonate, or compounds thereof.

It is likewise applicable in neutralizing any alkaline solution and precipitating therefrom the organic material previously held in solution or suspension by virtue of its alkalinity. The calcium carbonate always formed in our improved process aids in settling the material thrown out of solution, thus avoiding the expensive operating of filtering.

We claim:

A process for the treatment of alkaline factory-waste liquors preparatory to their disposal consisting in subjecting them to the action of a gas of approximately atmospheric pressure containing carbon dioxide until the alkaline liquor has absorbed more carbon dioxide than required to convert its alkaline content to carbonates, then adding untreated alkaline liquor until any bicarbonates present in the mixture are reverted to carbonates, then adding to the mixture cal cium chloride in order to form insoluble compounds, and finally removing the precipitated solids from the liquor.

In testimony whereof, we have signed this specification.

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