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METHOD OF RECOVERING FATTY ACIDS

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Fig. 1.

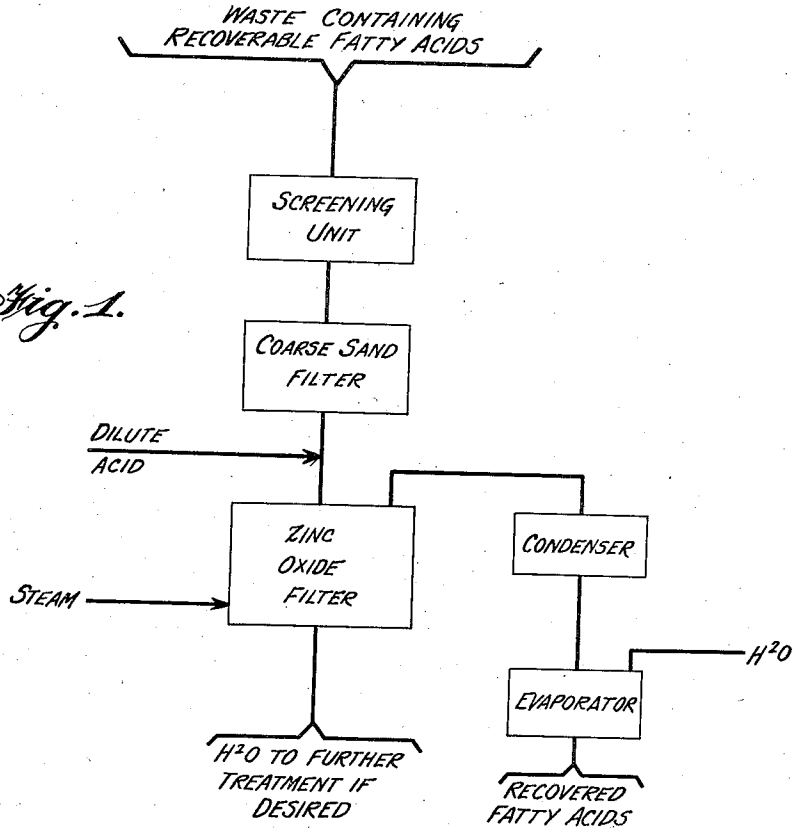
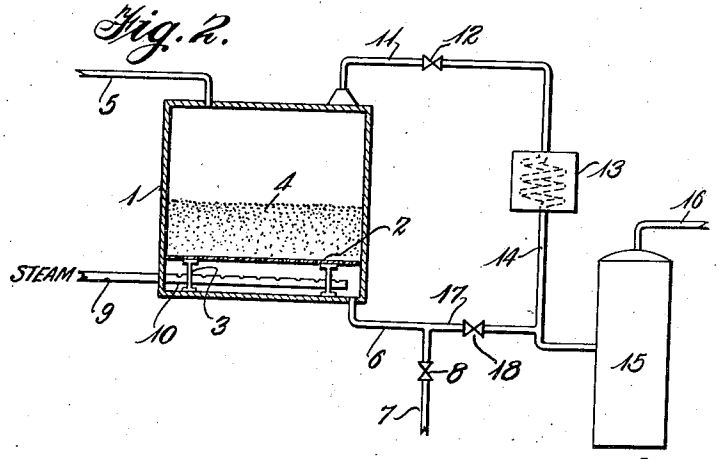


Fig. 2.



Inventors

Oliver M. Urbain and

William R. Stemen

By James P. Burns

Attorney

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METHOD OF RECOVERING FATTY ACIDS

Oliver M. Urbain and William R. Stemen, Columbus, Ohio, assignors to Charles H. Lewis, Harpster, Ohio

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5 Claims. (Cl. 260—412)

This invention relates to a process for recovering fatty acids from solutions containing the same. In its more specific aspect, the invention contemplates the recovery of the fatty acids present in the soaps discharged in waste waters from laundries and the like.

It is well-known that the wash waters or suds employed in laundering operations contain from 0.25 gram to 5.0 grams of fatty acids per liter. These fatty acids are, of course, present in the form of sodium and potassium salts, that is, in the form of soaps. In addition to soaps, the laundry wastes contain so-called soap builders, free alkali, dirt, dyes, greases, starch, carbohydrates, lint, and other cellulosic materials as well as various forms of bacteria.

The present process is primarily concerned with the steps of freeing the fatty acids from the soaps and recovering the same from the waste solution. The fatty acids may be released from the soap by effecting hydrolysis thereof through the addition of a dilute acid such as dilute hydrochloric to the waste.

When dilute hydrochloric acid is added to laundry waste or the like, the fatty acids are released from the soaps according to the following general reaction:

$$\underset{\text{Soap}}{R.COO.Na} + HCl \rightarrow \underset{\text{Fatty acid}}{R.COOH} + NaCl$$

A specific example of the general reaction above is given as follows:

$$\underset{\text{Sodium stearate}}{C_{17}H_{35}.COO.Na} + HCl \rightarrow \underset{\text{Stearic acid}}{C_{17}H_{35}.COOH} + NaCl$$

The above reactions take place at all pH's below pH 7.0, but even at pH's above pH 7.0 the soaps hydrolyze according to the following general reaction:

$$\underset{\text{Soap}}{R.COO.Na} + H_2O \rightleftarrows \underset{\text{Fatty acid}}{R.COOH} + NaOH$$

It should be noted that this reaction is of the reversible type. If the fatty acid formed on the right is removed, the hydrolysis of the soap will proceed to completion. In other words, as long as the pressure is eliminated from the right side of the reaction, it will continue to move to the right.

A specific example of the hydrolysis of a soap is given in the following reaction:

$$\underset{\text{Sodium palmitate}}{C_{15}H_{31}.COO.Na} + H_2O \rightleftarrows \underset{\text{Palmitic acid}}{C_{15}H_{31}.COOH} + NaOH$$

Coming now to a description of the present process, reference will be had to the accompanying drawing for clarification, wherein:

Figure 1 is a diagrammatic flow chart representing the various steps in the process; and

Figure 2 is a more or less diagrammatic illustration of a suitable filter structure for employment in removing the fatty acids.

Referring to the drawing, the waste containing the recoverable fatty acids is first passed through a screening unit to free the same of entrained solids and thence preferably passed through a coarse sand filter to remove such solids as might otherwise foul the subsequent chemical filter unit. There is added to the waste a dilute acid, such as hydrochloric acid, to induce hydrolysis of the contained soaps. The solution is then passed into a filter for removing fatty acids.

The filtering medium employed in the filter is of considerable importance in the present invention. It comprises a more or less chemically inert carrier in the form of granular coke or magnesia silicate brick impregnated with zinc oxide. In the present process the zinc oxide is the active reagent in the removal of the fatty acids. Zinc oxide has a solubility of 0.001 gram in 100 cc. of water at 20° C. at the saturation point so that very little of the reagent will be lost upon passage of the waste through the chemical filter. The filtering medium is preferably employed as a granular mass, the individual granules of which will pass a five-mesh screen and be retained on a twenty-mesh screen. The carriers are unreactive chemically and withstand high temperatures without affecting their physical structures. Additionally they are inexpensive and produced in almost unlimited quantities.

To obtain the filtering medium, that is, the carrier, impregnated with zinc oxide, the carrier is pickled in a saturated solution of zinc nitrate or zinc chloride until the granules of the carrier become thoroughly saturated with the reagent. The excess reagent is then drawn off and the granulated mass dried in a current of warm air, say, at a temperature of around 120° C. After drying, the material is ignited at a temperature ranging from 600° C. to 900° C. At this temperature the zinc nitrate or the zinc chloride will be converted to zinc oxide. Regardless of the source from which it is derived, the active reagent is zinc oxide.

When a waste solution containing fatty acids is passed over this material, the following reaction will take place:

$$ZnO + 2R.COOH = \underset{\text{Zinc salt of fatty acid}}{Zn(OOCR)_2} + H_2O$$
(Fatty acid)

From the above reaction it is seen that there

is formed on the surface of the granules in the chemical filter a zinc salt of the fatty acids. When the material has become exhausted, it can be regenerated and the fatty acids released by passing superheated steam through the material. The reaction is as follows:

$$Zn(OOCR)_2 + H_2O = ZnO + 2R.COOH$$

Zinc salt of fatty acid — Steam — Fatty acid

It should be noted that the first reaction is dependent upon the speed of the hydrolysis of the fatty acid salts, but since we are removing the fatty acids as fast as they are released by hydrolysis, the hydrolysis reaction proceeds with great rapidity and the whole procedure requires less than fifteen minutes, provided of course that the ZnO is at all times in excess of the fatty acid content.

The second reaction is complete within a few minutes' time as hot steam breaks down the zinc salts of the fatty acids very readily and very easily. The steam which is introduced into the chemical filter carries over with it the fatty acids, thus functioning to remove the same from the filter and regenerate the latter. The steam carrying its fatty acid content is passed to a suitable condenser, and the condensate is thence delivered to a conventional evaporating unit in which the water is liberated and the fatty acids recovered.

The apparatus instrumentalities employed in carrying out the process of the present invention are more or less conventional and relatively unimportant to the process. It is accordingly not believed necessary that they be specifically illustrated. The screening unit is employed to remove the heavy suspended matter from the waste. Such screens are self-discharging, and the solids removed by the screens may be flushed directly into a suitable sewer or the like.

The mechanical sand filter is employed to remove such suspended matter as passes the screens and to insure that no suspended matter will pass into and foul the fatty acid recovery unit. The sand filter can, of course, be equipped with a conventional back-wash through the medium of which it may be back-washed with clear water after each day's run. The back-wash water will, of course, carry the solids from the sand filter and may be likewise discharged into a suitable sewer or the like.

A suitable construction for the fatty acid recovery unit is illustrated in Figure 2 wherein the filtering chamber is designated generally at 1 and constitutes a suitable sheet metal container since it is not required to withstand excessive pressure or temperature conditions. The chamber 1 is provided with a filtering medium carrying grate 2 suitably supported on members 3, the filtering agent diagrammatically illustrated at 4, and the line 5 through which the solution containing the fatty acids to be recovered is introduced to the filtering chamber.

The filtrate leaves the bottom of the chamber through the line 6 and may be discharged through branch line 7 controlled by the valve 8 for further treatment or into a sewer as may be desired. A steam line 9 extends into the bottom of the chamber 1 and is provided with a perforated extension 10 for delivering steam below the filtering medium for the purpose of driving off the fatty acids from the filter. The steam carrying its fatty acid content leaves the top of the filter through line 11 controlled by valve 12 and passes to the condenser 13. The condensate is then delivered through line 14 to a suitable evaporating unit 15 wherein the water is driven off through the line 16 and the fatty acids are recovered.

Oftentimes during the introduction of steam to the filtering chamber 1, condensation occurs in the filtering medium, and the condensate carrying some of the fatty acids passes out through the line 6. In this case the valve 8 can be closed and this condensate passed through the by-pass line 17 controlled by the valve 18 and introduced to the line 14 to flow with the condensate from the condenser 13 to the evaporator 15.

It will be understood that the process is not dependent upon this particular form of apparatus, nor is the invention to be limited by the foregoing description beyond the scope of the subjoined claims.

Having thus described our invention, what we claim is:

1. In a process for the recovery of fatty acids from solutions containing the same, the step comprising effecting chemical removal of the fatty acids by passing the solution through a filter charged with zinc oxide and thereafter effecting recovery of said fatty acids by treatment of the zinc oxide filter.

2. A process for the recovery of fatty acids from solutions containing the same, comprising effecting chemical removal of the fatty acids by passing the solution through a filter charged with zinc oxide, thereafter passing steam therethrough to free the fatty acids from the filter and carry them over to a condenser, and finally evaporating the water from the condensate and recovering the resulting fatty acids as a product of the process.

3. A process for recovering fatty acids from soap solutions comprising adding a dilute acid to the soap solution to release the fatty acids from the soap by hydrolysis, passing the solution through a filter charged with zinc oxide to chemically remove the fatty acid product of the hydrolysis reaction, and finally recovering the fatty acids from the filter.

4. A process for recovering fatty acids from laundry waste comprising adding to the waste a quantity of HCl to effect hydrolysis of the soap solution and release of the fatty acids, chemically removing the fatty acids as released by effecting the hydrolysis in the presence of a zinc oxide carrying reagent, and finally recovering the fatty acids from said zinc oxide carrying reagent.

5. In a process for recovering fatty acids from solutions containing the same, the step comprising effecting chemical removal of the fatty acids by passing the solution through a filter composed of substantially inert granular material impregnated with zinc oxide and thereafter effecting recovery of said fatty acids by treatment of the zinc oxide filter.

OLIVER M. URBAIN.
WILLIAM R. STEMEN.