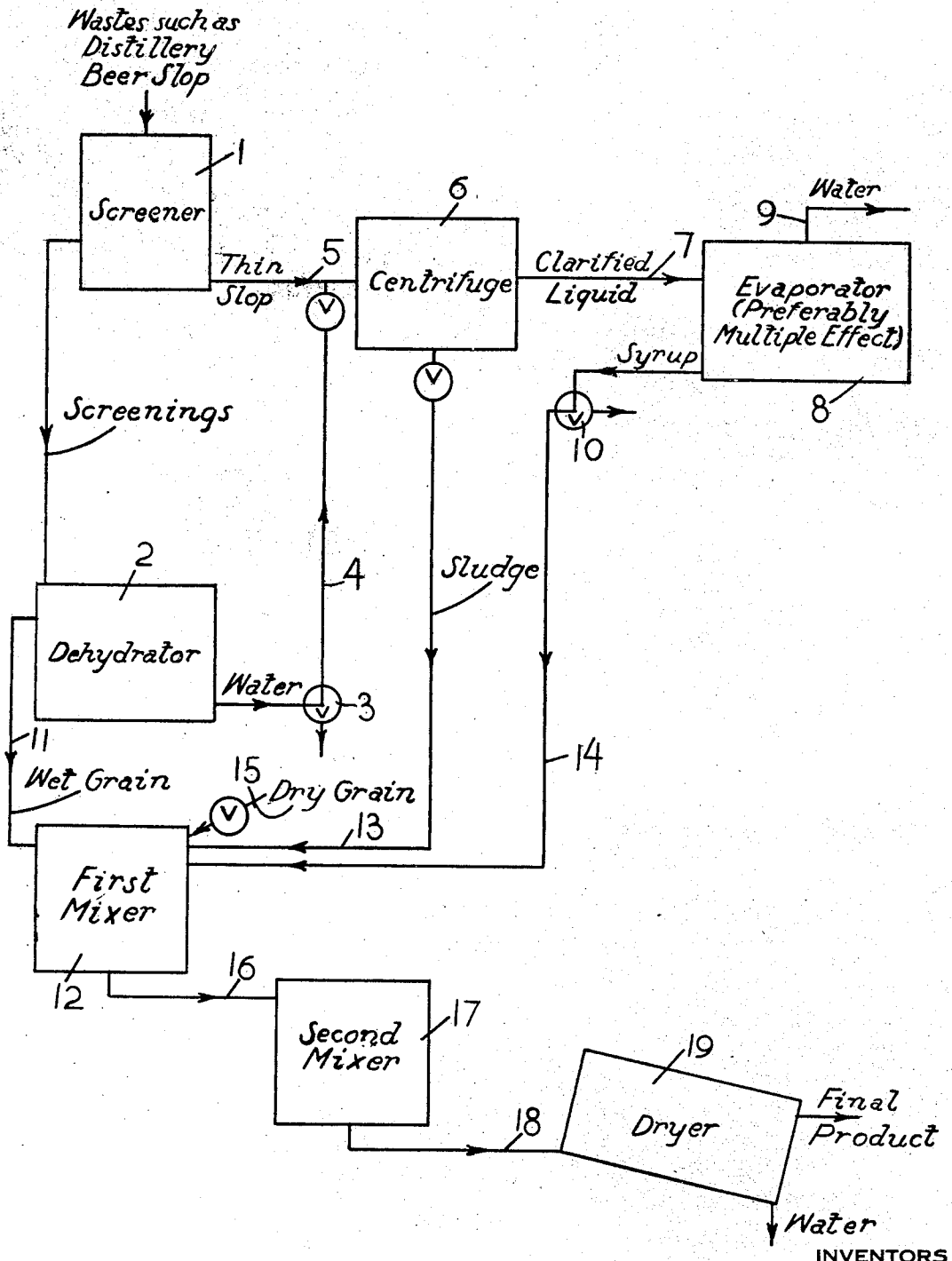
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PROCESS FOR THE DEHYDRATION OF MOISTURE-CONTAINING COMPOUNDS

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PROCESS FOR THE DEHYDRATION OF MOISTURE-CONTAINING COMPOUNDS

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3 Claims. (Cl. 99—5)

This invention relates to the dehydration of moisture-containing compounds of matter as, for example, the treatment of distillery beer slops or spent beer for the removal of most of their water content so that the residue may be employed for various purposes, such as used for feed and/or fertilizer.

The principal object of the invention is to provide a process for the dehydration of moisture-containing compounds of matter, which process extracts much of the moisture contents by relatively inexpensive mechanical steps prior to the final and generally more expensive evaporative step.

Another object is to provide a process as above, whereby a larger volume of moisture is efficiently removed from the composition, prior to the more expensive final heat-drying step, than is found possible to remove by employing heretofore existing processes.

Still another object is to provide a liquid-removing process for the treatment of liquid-containing products, which process extracts much of the liquid in the early steps of the process, thus relieving work falling upon pumps or the like which may be employed in carrying out the later steps.

Another object of the invention, related to the last named object, is to extract much of the liquid in the early steps of the process so that smaller conduits, conveyors, and the like, as well as less bulky apparatus, may be employed, if desired, in the later steps of the process.

Yet another important object is to provide dehydrative steps, prior to the final evaporative step, which will obviate or reduce the fouling of dryer tubes.

Another object of great importance is the provision of a process which will extract the finer materials, the gelatinous material, the material in a colloidal state, and similar materials difficult to separate from the liquids.

Still another object, related to the last, is to provide a process whereby these difficult-to-separate substances are removed without the necessity of recentrifuging, although recentrifuging had been thought necessary and so taught in the past.

A further object is to provide a process for the purpose stated which requires no settling steps whatever.

Another object is to provide such a process which contains no step that is apt to slow up a subsequent step in the process, but the steps are so coordinated that a rapid production of the finished product is assured.

Other objects and advantages of this invention will be apparent during the course of the following detailed description of the invention taken in connection with the accompanying drawing, forming a part of this specification and which drawing is a flow-sheet or diagrammatic representation of the steps in the process.

While the novel process herein described may be applied to the treatment of various moisture-containing compositions of matter such as, for example, cannery wastes, garbage, and packing house wastes, it has been found particularly applicable to the treatment of brewers' grains and distillery beer slops and will be detailed in connection with the treatment thereof using, only as an example, the treatment of distillery slops from a twenty-thousand-bushel per day distillery, the by-product to be converted ultimately into cattle feed.

Distillery beer slops or wastes contain substantially 94.5% by weight liquid and 5.5% by weight solids. Upon running the slops through a suitable screener 1, a common step in the art, screenings or generally watery, coarse solids are yielded, containing substantially 80% by weight liquid and 20% by weight solids, while the other product of the screener 1 is a thin slop containing substantially 96 to 97% by weight liquid and 3 to 4% (generally substantially 3.4%) by weight solids.

Standard practice has been to put the wet screenings or watery coarse solids through various extracting devices and lower the liquid content from substantially 80% by weight to about 70% by weight.

However, in the new process herein disclosed, the wet screenings are passed through a high-pressure press, known as a dehydrator 2, wherein the liquid content is lowered from substantially 80 parts by weight to substantially 57 parts by weight. In other words, by this step, the weight of liquid is lowered from substantially 467,000 pounds per day, as in standard practice, to substantially 265,000 pounds per day. The pressed-out and drain liquids (substantially 23 parts by weight and containing valuable solids and matter in a colloidal state), may be drawn off, as by the valve 3, or all or a portion may be conducted, as at 4, to the thin slop line 5, where it and the thin slop may run together and empty into a centrifuge 6 for further treatment.

According to the older or standard practice, the thin slop after a short settling step if thought

desirable, was passed to multiple-effect evaporators where the material was evaporated up to substantially 17% by weight solids but it was found impossible to evaporate beyond 25% by weight solids, no matter how carefully the evaporative step was carried out, because at this concentration there was a great increase in viscosity. Therefore, the older processes left in this concentrate or syrup substantially 83% by weight water to 17% by weight solids, despite that these evaporators consume large quantities of steam.

However, in the present new process, it was found possible ultimately, to concentrate the thin slop to as much as 75% by weight solids if the suspended solids were first removed from the thin slop. Filtration was found possible, but centrifuging in preferably a basket-type extractor, which is also commonly termed a centrifuge 6, was more feasible.

In the older or standard processes, the use of centrifuges was known but these were employed for removing the coarse solids from the distillery wastes and left much of the finer grained and gelatinous materials in the discharged liquids, so that it was impossible to evaporate such a liquid to substantially 50% by weight solids and have it retain its food value. Furthermore, the solids discharged from the centrifuge to which was added whole unscreened slop, contained considerable moisture when attempts were made to express the water from it, the greater portion of the gelatinous material which was present in the mass was squeezed out with the liquid thus making it necessary to recentrifuge.

The thin slop of the new process herein disclosed, even containing a portion or all of the pressed out liquid (substantially all water) referred to, may be readily concentrated to a sludge containing substantially 20% by weight solids and 80% by weight liquid, while the clarified liquid or slop which contain substantially 2.8% by weight of valuable solids is conducted as at 7 to preferably a multiple-effect evaporator 8 where the clarified liquid or slop is converted into a syrup which has a solid content of substantially 50% by weight and this may be increased, by careful operation, to 60 or even 75% by weight solids. The evaporator is adapted to reduce the weight of the clarified liquid, in producing the syrup, to a syrup of substantially 5.5% by weight and distilled water of substantially 94.5% by weight. Thus, comparing the syrups of the older or standand processes, which syrups may contain 17 to possibly 25% by weight solids, and 75 to 83% by weight liquid, the new process produces a syrup containing at least 50%, and up to 75%, by weight solids. Expressing the differences in pounds, the older processes leave in the syrup substantially 1,063,000 pounds liquid against 177,000 pounds liquid when the syrup is processed according to the present disclosed method, or a reduction of liquid content of substantially 886,000 pounds.

The water which may be distilled in the evaporator 8 is slightly over 97% by weight of the total liquid weight of the clarified liquid introduced into the evaporator 8. As an example, if the total weight of the clarified liquid is 6,435,000 pounds, of which 177,000 pounds are solids and 6,258,000 pounds liquid, by the expenditure of substantially 2,310,000 pounds steam in the evaporator, the result will be substantially 354,000 pounds syrup containing 177,000 pounds solids and 177,000 pounds liquid, the balance of the liquid, i. e., 6,081,000 pounds water being distilled, and may be drawn off as at 9.

The syrup produced by this novel process has qualities not found in the old process syrup above the increased concentration of the new product. There is none of the bacterial souring characteristic of old process syrup, the new syrup having a better odor, is more stable and while concentrated beyond the concentration of the older processed syrup, is really easier to handle.

The syrup may be drawn off from the evaporator 8 as by the valve 10.

It is important to note that, whereas from 3 to 4 pounds water may be evaporated at the expenditure of one pound steam in the multiple effect evaporator, in the early step of the new process, the rotary steam driers of the standard or older processes required about 1¼ pounds steam in order to evaporate substantially one pound water from wet grain.

Referring again to the product of the dehydrator 2, in addition to the liquid content which is drawn off at 3, wet grain or coarse solids residue is produced which contain substantially 57% by weight liquid and 43% by weight solids. This wet grain or coarse solids residue is suitably conducted, as at 11, to a mixer 12 into which may also empty the sludge, containing the suspended solids removed from the thin slop, at at 13, the syrup as at 14, and a dry grain conductor 15.

It has been discovered that the sludge must be added in small pieces to the wet grain and thoroughly mixed so that no particles of sludge must be left in the mix.

As for the addition of the dry grain, this may be a recycled portion of the final product, if desired, and its addition converts the mix into a more uniform product and it dries much easier.

Preferably, the mixer 12, which may be termed the first mixer, is of the type having sludge feeders, a helicoid conveyor and a double-paddle mixer element.

The mix from the first mixer 12, with or without the addition of the syrup, is preferably next conveyed, as at 16, to a second mixer 17 where it is further homogenized and rendered fluffy, this being preferably carried out in the second mixer where there is but the one inflowing material.

By the time the mix is thoroughly homogenized and fluffed in the mixer 17, it may be said to represent from 40 to 45% (substantially 41.8% in most cases) by weight solids, minus recycled dry grain or the like, or substantially 49% by weight solids when the dry grain has been added. Consequently, the liquid content is substantially from 51 to 58.2% by weight.

Referring, at this point, to the weight of solids and liquid in the product introduced into the first of the two driers usually employed in the older or conventional processes, the product is made up of substantially 30% by weight solids and 70% by weight moisture, and when introduced into the second of the driers of the older or conventional processes, substantially 63% by weight of this moisture had been driven off by the expenditure of steam. Since the older or conventional processes called for the feeding of the syrup (containing substantially 17% by weight solids and consequently substantially 83% by weight water) into the feed line between the first and second driers, the second drier was required to remove substantially 70% by weight moisture so as to provide a final product containing substantially 7% by weight moisture. This high moisture removal was usually carried

on by the employment of a large volume of steam or hot air.

On the contrary, by the new process herein set out, the thoroughly homogenized mixture may be conveyed, as at 18, to a drier 19 which drier is required to remove but 50% by weight of water in order to produce the same weight of final product having the same moisture content (substantially 7% by weight of moisture). It is therefore apparent that a large saving of steam or similar medium is effected in the new process herein disclosed. These several facts may be aptly presented in the following summary:

	Standard processes, pounds	New process, pounds
Water removed in evaporators	5,153,000	6,081,000
Water removed in driers	1,499,000	571,000
Total water removed	6,652,000	6,652,000
Steam consumed in evaporators	1,950,000	2,310,000
Steam consumed in driers	1,499,000	571,000
Total steam consumed	3,449,000	2,881,000
Steam savings per day		568,000

By the treatment of the thin slop, and the subsequent treatment of the clarified liquid as set out in this specification, and the feeding of the syrup produced into the first mixer 12, rather than the treatment of the thin slop to produce, in the next step, a syrup, as in standard practice, and the feeding of this syrup to the driers, the new process requires but one pound water to be evaporated from the syrup in the rotary steam drier so as to recover one pound solids, as against the evaporation of five pounds water for the recovery of one pound solids of syrup made by the standard processes.

Not only is there this economy in the use of steam possible by the utilization of the new process, but it is found that the great difficulties usually encountered from the coating and clogging of the tubes of the rotary steam driers is obviated in the new process, which feeds the composition of matter to the drier 19 with its liquid content materially reduced by the prior steps, insuring that the drier tubes remain clean. Therefore, it is not necessary to suspend operations in order to clean out these tubes, when employing this new process.

Since the syrup produced and set out has important uses in addition to its use as a portion of the final product herein described, the steps in its production are detailed and claimed in a co-pending application bearing Serial Number 8,201, filed February 25, 1935. It is apparent that in the production of the final product obtained by the steps herein disclosed, the steps need not include the production of the syrup itself, since the syrup may be obtained under the process covered by the co-pending application and utilized in the production of the final product obtained by the subsequent steps herein disclosed. In fact, in applying the process herein disclosed to the dehydration of other waste products, such as cannery wastes, while a syrup of the general character of distillers' syrups might be obtained, such wastes would ordinarily yield: the watery coarse solids, thin slop, sludge, coarse solids residue and, ultimately, when properly mixed and dried as set out, a final product of the nature herein disclosed.

Various changes may be made to the form of the invention herein shown and described without departing from the spirit of the invention and scope of the following claims.

What is claimed is:

1. The process of dehydrating distillery beer slops, which consists in separating said slops into screenings and thin slop, extracting substantially 23% by weight liquid from said screenings and leaving a wet-grain residue containing substantially 43% by weight solids, adding said liquid and said thin slop one to the other, centrifuging said added liquid and thin slop into a sludge, containing substantially 20% by weight solids, and a clarified slop, evaporating said clarified slop to a syrup containing substantially 50% by weight solids, adding said wet-grain residue, sludge and syrup together, said sludge being added in small pieces only, mixing said wet-grain residue, sludge and syrup until said mixture is in a fluffy condition, and drying said mix.

2. A quick cycle process for the treatment of wastes from distilleries and the like ordinarily called distillery slop, which consists in an initial step of screening the distillery slop to provide wet solid screenings and a thin slop having therein fine solids in suspension, second, separating said screenings into a wet grain solid and extracted water, mixing at least a portion of the extracted water with the thin slop of the initial separation step, centrifugally treating the said thin slop and added water to provide a sludge and a clarified liquid, mixing the sludge with the wet grain solid, subjecting the clarified liquid to an evaporation treatment for the evaporation of water therefrom and to provide a residue syrup portion, adding at least a portion of said syrup portion to the wet grain solid and sludge in the mixing step aforesaid, subjecting the resultant mixture to a second mixing treatment for rendering it homogeneous and fluffy, and drying the resultant mixture.

3. A quick cycle process for the treatment of wastes from distilleries and the like ordinarily called distillery slop which consists in an initial step of screening the distillery slop to provide wet solid screenings and a thin slop having therein fine solids in suspension, second, separating said screenings into a wet grain solid and extracted water, mixing at least a portion of the extracted water with the thin slop, centrifugally treating the said thin slop and added water to provide a sludge and a clarified liquid, mixing the sludge with the wet grain solid, subjecting the clarified liquid to an evaporation treatment for the evaporation of water therefrom and to provide a residue syrup portion, adding at least a portion of said syrup portion to the wet grain solid and sludge in the mixing step aforesaid, subjecting the resultant mixture to a second mixing treatment for rendering it homogeneous and fluffy, drying the resultant mixture, and adding at least a portion of the dried product together with the wet grain solid, sludge, and syrup in the sludge and wet grain solid mixing step above mentioned.

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