ABSTRACT: A process and plant for scouring wool, wherein the wool is treated with a dry cleaning agent, such as for instance trichloroethylene or perchlorethylene, and used cleaning agent is separated from the wool and washed with a mixture of water and alcohol, the cleaning agent containing wool, grease being then separated from the water and alcohol and recovered in a solvent recovery low pressure and low temperature distillation apparatus.
METHOD FOR SCOURING WOOL

This invention relates to a process of scouring raw wool, to plant for the performance of such process and a method based on the process for recovering the cleaning agent used in the scouring process and producing purified wool grease.

The invention thus consists in a process of scouring wool comprising treating wool with a dry cleaning agent, such as for instance trichloroethylene or perchlorethylene, separating the used cleaning agent from the wool, washing the cleaning agent with a mixture of water and alcohol, separating the cleaning agent, containing wool grease, from the water and alcohol, and recovering the cleaning agent in a solvent recovery low pressure and temperature distillation plant.

The invention further consists in wool scouring plant comprising at least one cleaning machine and means for passing and recycling a cleaning agent through the machine and is characterized by a solvent recovery low pressure and temperature distillation plant, which may operate in three stages and incorporate a thin film evaporator device. The use of such distillation plant materially avoids degradation of the wool grease.

During the phase separation dirt and water soluble impurities pass into the water/alcohol phase and the wool grease remains in the solvent phase.

The wool grease therefore passes into the still with the cleaning agent and is tapped off from the bottom of the still after distillation of the solvent.

The purified solvent is reused for scouring further batches of raw wool.

One particular and at present preferred form of plant, to be described only by way of nonlimitative example is diagrammatically illustrated in the accompanying drawings, in which FIG. 1 is a combined block and flow diagram illustrating the plant components and their interrelation in the operation of the process;

FIG. 2 illustrates the cooling water system;

FIG. 3 illustrates the hot water system;

FIGS. 4 and 5 are side elevation and plan views respectively of a convenient plant layout.

Referring now to these drawings, there is shown a battery of eight Permac Bowe dry cleaning machines 1, each having an associated 500 gallon tank. These machines are coupled to an air cooling system including an activated carbon adsorber 3 connected to the atmosphere and an air cooler 4 connected to a water separator (not shown). The cleaning machines are also connected to a 3000 gallon buffer tank 5 for solvent/grease mixture and also to a solvent tank for spent solvent. The buffer tank 6 is in turn connected to a series of three decanters 7A, 7B, 7C each of 3000 gallon capacity and including a mixing device. The decanters could be replaced by a centrifuge which would perform the same function. The outlets from these decanters are connected to a steam operated evaporator 8 for the recovery of alcohol/water mixture from the cleaning solvent. This evaporator may have a 450 sq. ft. exchange surface and include a stirrer. The evaporator 8 is connected to a double roller drier 9 for drying dirt and solvent mixture and to a condenser and receiver 10 for condensing alcohol/water mixture.

FIGS. 4 and 5 show a solvent storage tank 11 of 3,000 gallon capacity, and there is also an alcohol storage tank not shown of 500 gallon capacity.

FIGS. 1, 4 and 5 also show a first stage evaporator 13 including a falling film evaporator. In FIG. 1 there is also shown a first stage steam ejector 14, a first stage condenser 15, a second stage evaporator 16 of the wiped thin film type, a second stage tubular condenser 17, a third stage wiped thin film evaporator 18 and a thermocompressor 19 including intermediate condenser 19 and steam ejector.

FIG. 2 shows a cooling system including two packaged water chillers 20 and a packaged cooling tower 21. FIG. 3 shows a hot water system 22 to provide process water at 60-65°C.

The mode of use of the plant as above described is as follows:

The scouring of the wool takes place in the dry cleaning machines 1; the cycle time for each load (208 pounds of dirty wool) is 20 minutes including loading, two washes, drying, cooling and unloading. It is found to be most economical to lose one gallon of solvent (e.g. perchlorethylene) per 600 lbs. of clean wool as the excessive steam consumption for further drying would counterbalance the additional gain in solvent. The loss of solvent carried along with the cooling air is however cut to a minimum by using the chilled water cooler and the activated carbon adsorption plant. The spent solvent from the first wash containing the suint, dirt and grease is pumped into the buffer tank 6, whereas the solvent from the second wash is pumped into the tanks 2 which are associated with the washing machines to be used for the first wash of the next load.

From the buffer tank 6 the spent solvent is continuously mixed with a water/isopropyl alcohol mixture which dissolves the suint and dirt, forming a suspension which is separated from the solvent/grease mixture in the decanters 7A, 7B, 7C. The water/alcohol mixture containing suint and dirt is led to the evaporator 8 which recovers the alcohol and water by distillation. The bottom stream from the evaporator 8 is fed on to the double roller drier 9 where the remaining alcohol and the alcohol and water and discharges the suint and dirt as a dry powder. This dry powder may be usefully employed in agriculture.

The solvent containing the grease is fed from the last decanter 7C into the other buffer tank 5 where it is mixed with grease-free solvent returning from the solvent recovery part of the plant. To minimize the size of the recovery section the concentration of grease in this tank should be kept as high as possible. A grease content of about 3 percent to about 7 percent and preferably of 5 percent by weight has been found acceptable to the scouring process.

The buffer tank 5 is bled continuously to the solvent recovery section which is in three stages. In the first stage the bulk of the solvent is recovered in the tubular evaporator 13 under a pressure of about 25 mm. Hg Abs. and the preconcentrated grease is led to the second stage which is the agitated thin film evaporator 16. Here the preconcentrated grease flows over a heated wall in a thin film which is being agitated by a rotor under pressure of about 12 mm. Hg Abs. Further concentration takes place, while the solvent is condensed and recovered in the tubular condenser 17. The third stage is similar to the second stage but operates at even lower pressure e.g. about 2 mm. Hg Abs. and includes steam stripping which ensures the removal of the last traces of solvent and some lower boiling impurities of the grease. Wool grease of high quality is discharged from the third stage ready to be packed and sold. In order to condense the solvent and the stripping steam from the third stage the thermocompressor 19 is used. The resulting solvent/ water mixture is consequently separated in a decanter before the solvent is passed back to the buffer tank 5. In order to avoid degradation of the wool grease during the solvent recovery stage hot water is used as the heating medium throughout the process.

Each cleaning machine has a button trap and an optionally associated filter unit through which the cleaning solvent is pumped before it is returned to the wool in the drum of the machine. Each filter unit is of the diatomaceous earth type and filters down to 4 microns. It is essential periodically to clean the filter units and this is done by pumping clean grease laden solvent from the buffer tank 5 in reverse direction, thus causing dirt and filter powder to be washed away and carried to the buffer tank 6. No additives are normally required.

The drums of the cleaning machines are preferably lined with perforated fabric. By use of the plant as specifically described, 5,000 pounds of dirty wool (e.g. 53 percent wool, 15 percent grease, 20 percent suint and dirt and 12 percent moisture) can be treated per hour with about 3,000 gallons of perchlorethylene to yield 750 pounds per hour of highly purified grease.

The invention is applicable to most chlorinated hydrocarbon dry cleaning agents with or without addition of alcohols, e.g. 5 percent isobutyl alcohol or cyclohexane.
I claim:

1. A process of scouring wool comprising treating wool with a dry cleaning agent selected from the group consisting of trichloroethylene or perchlorethylene, separating the used cleaning agent from the wool and washing the cleaning agent with a mixture of water and a lower alkyl monohydric alcohol, separating the cleaning agent, containing wool grease, from the water and alcohol and recovering the cleaning agent by low pressure and low temperature distillation.

2. A process of scouring wool and recovering wool grease comprising treating wool with a dry cleaning agent selected from the group consisting of trichloroethylene or perchlorethylene under cooled conditions, separating the used cleaning agent from the wool and continuously washing it with a mixture of water and a lower alkyl monohydric alcohol, recovering the alcohol and water by distillation and recovering the cleaning agent by multistage low pressure and temperature distillation.

3. A process of scouring wool as set forth in claim 1 wherein the cleaning agent is recovered in three stages under progressively lower pressures, the second of said stages involving thin film evaporation and the third stage including steam stripping.

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