Spectrum

Cleaner effluents from wool-scouring mills

Wool-scouring—removing the grease and dirt from wool—yields a murky effluent. Not so long ago nobody worried too much. Scourers here and overseas were able to discharge their waste water cheaply into city sewer systems.

But times have changed. As standards of sewage treatment have improved in all wool-processing countries, sewerage authorities have vastly increased their charges for receiving industrial liquid wastes.

Because of this, wool, still Australia's number-one money-spinner, is in real danger of becoming priced out of some markets unless an economical way of cleaning the scouring effluent can be found.

Some figures will illustrate the problem. During scouring, each 100 kg of average-fleece wool yields only some 63 kg of clean wool. The other 37 kg is a mixture of dirt, grease, and salty sheep sweat (suint), which finishes up along with about one kilogram of detergent in about 1500 litres of water.

A typical scouring machine in Australia processes about 3000 tonnes of greasy wool each year. So, in doing so, it yields about 45 million litres of water containing about 1000 tonnes of impurities.

Until recently, discharging this waste water into the sewer cost the mills only a few thousand dollars each year—they were charged 10–15 cents per 1000 litres. Now they must usually pay not only for the volume of the liquid, but between $50 and $100 for each tonne of impurities too. So the cost of disposing of those 45 million litres has increased to some $70 000 a year.

To date it has been technically possible to clean wool-scouring liquors before discharging them into the sewers, but exorbitantly expensive. Consequently, most mills here and overseas have put off installing effluent-cleaning equipment in the hope that something better will turn up.

At Geelong, the CSIRO Division of Textile Industry has tackled the problem by modifying the scouring process itself so that this will yield a sludge and an acceptably clean waste water. Together these can be disposed of for about one-quarter of the price of directly discharging untreated effluent into the sewer. The Division has called this modification the 'Lo-flo' process.

With scouring equipment currently in use, the impurities in the waste liquor remain as a stable suspension. The problem is: how do you economically break this down?

One of the most commonly used methods is to add chemicals that flocculate the suspended grease globules; these aggregate into large clumps that can be removed by centrifuging. Unfortunately, the high cost of the chemicals added makes this a rather expensive approach.

Under the leadership of Dr George Wood, the CSIRO workers have found a way of making the liquor flocculate without adding chemicals at all. Instead, the new process uses substances already present to do the job—mainly suint and detergent chemicals.

Normally, these constituents occur in the liquor in much too low a concentration to have any effect. However, the CSIRO scientists have found that if the suint and detergent reach a critical level then the suspended contaminants flocculate out. Simply reducing the amount of water used during scouring will achieve the required concentration, and the 'Lo-flo' process makes use of this fact.

The scouring liquor contains three types of suspended particles:

- molten droplets of pale, relatively clean grease kept stable by a thin layer of detergent surrounding them
- darker grease droplets (also surrounded by a layer of detergent) containing dirt, water, and detergent
- dirt particles that may have bits of dark grease sticking to them

The first and last types can be fairly easily removed by centrifuging, so only the dirty mixed globules create difficulties.

Suint is the key to dealing with these problem grease particles in the 'Lo-flo' process. As its concentration builds up, the properties of the particles change and they begin to aggregate. At the same time the density of the liquor increases, with the result that the problem particles become more buoyant. With centrifuging, they can be made to speedily rise to the surface where they can be skimmed off along with the cleaner grease particles.

Meanwhile the detergent is also having an effect. It causes the dirt in the grease droplets to separate, so this sinks to the bottom where it adds to the already accumulating sludge of dirt. Thus the grease and dirt can be almost completely separated both from the liquor and from one another.

The liquor that remains still contains detergent, suint, and other dissolved substances. These can still be used to flocculate suspended grease and dirt, so the cleaned liquor is returned to the machine.

In spite of this recycling, the concentration of dissolved substances in the liquor doesn't go on rising indefinitely. A small amount of water goes out with the grease

and the dirt-containing sludge that settles on the bottom. This water, of course, also contains the dissolved substances, and eventually the amounts in the small quantities of water removed balance the amounts being introduced into the scouring machine.

During scouring, the greasy wool passes through a succession of washing bowls, becoming progressively cleaner in each one. The hot water containing detergent passes through the bowls in the opposite direction.

Existing scouring machines cannot be run with a greatly reduced input of water. Their washing bowls are not designed to operate for long periods without being cleaned. Yet obviously it would be extremely costly for scourers to re-equip completely.

To avoid this, Dr Wood and his team have come up with a conversion unit that can be easily substituted for one of the washing bowls in existing machinery.

Most scouring machines contain four or five such bowls. The conversion unit (which contains three specially designed small bowls) can be fitted into the space taken up by the first one.

Much of the grease and dirt is then removed in these three small bowls using a minimum of water. The wool then passes as before to the remaining three original bowls, which still operate using the larger volume of water. However, 95% of the grease and dirt have already been removed from the wool in the first three small bowls. Thus the effluent coming from the last three only contains a small amount of impurities, for which the mill will not have to pay a large surcharge when discharging into the sewer.

So the CSIRO modification to the scouring machinery doesn't actually reduce the amount of water used during scouring; it merely ensures that the same volume of effluent is clean.

The dirt-containing sludge from the 'Lo-flo' process consists of about equal proportions of water and of dirt and grease.

Of the original 1000 tonnes of dry solids coming each year from that typical scouring machine, about 700 tonnes finish up in the sludge. This costs about $11 000 to dispose of. Add to this $5000 for the extra operating costs of the 'Lo-flo' process, and $6000 for discharging the cleaned scouring liquor down the sewer, and the total disposal cost comes to about $22 000. Compare that with the $70 000-odd to be paid if untreated waste water goes down the sewer!

In addition, the CSIRO process recovers nearly twice as much clean grease as any existing one, and high-quality wool grease is a valuable commodity that can be refined into lanolin and sold for cosmetic and pharmaceutical purposes. Lower-quality grease also has industrial uses. Thus greater grease recovery by the 'Lo-flo' process reduces operating costs still further.