Helping abattoirs come clean

Obviously, any operation that kills and processes around 3000 animals each day is going to create waste-disposal problems. Cleansing the 900 000-odd litres of waste water that result from the daily processing operations of any reasonably large meatworks is no easy task.

At Cannon Hill, a suburb of Brisbane, the CSIRO Meat Research Laboratory has for a number of years been looking into such difficulties. The Laboratory's approach has been to carry out surveys to isolate the problems, and then to study ways of getting over them.

Three years ago, Mr Alex Graham of the Laboratory surveyed 24 abattoirs in Queensland, New South Wales, and Western Australia. He found that some of them would be hard-pressed to achieve the standards for cleanliness of effluents laid down by the Sydney Metropolitan Sewerage and Drainage Board. (He took these standards as a guide for legislation likely to be passed elsewhere in Australia.) Mr Graham went through the abattoirs process by process, and he was able to come up with a number of suggestions for lessening the pollution problems.

Typically, abattoir effluents contain high levels of organic wastes and nitrogen, as well as relatively large concentrations of suspended and dissolved solids and grease. Treatment at the works can reduce these levels.

All 24 of the meatworks in Mr Graham's survey carried out 'primary' treatment to remove grease and solids from their waste water. Most did this by screening out the larger solids, and then separating out the floatable and settleable solids in a 'save-all'—a settling chamber that usually has a mechanical scraper for taking off the fat layer on the surface. If not overloaded, these 'save-alls' can work very efficiently.

At that time, only 11 of the abbattoirs gave their effluent a secondary treatment. This usually consists of letting bacteria and algae purify the effluent in first anaerobic and then aerobic ponds. Of course such a treatment adds considerably to the cost of dealing with the effluent, but it can reduce the ammonia, organic content (including blood), and acidity of the effluent very considerably.

It doesn't take that much blood to discolour a river for a kilometre or more down stream.

Interestingly, the meatworks with the most efficient primary and secondary treatment system also used considerably less water than average—only 1200 litres per head slaughtered compared with an average of 2000 litres per head. Water usage by the 24 abattoirs varied between 3800 and only 1000 gallons per head. ('Per head' refers to the number of cattle slaughtered, or the èquivalent number of sheep or pigs.) These figures prove nothing in themselves, but they do point towards the conclusion that the cleanliness of the effluent from each individual meatworks depends very much on its housekeeping.

Dealing with blood

Blood in the effluent represents a particularly difficult problem for older abattoirs that don't have secondary treatment systems. Unfortunately, primary treatment makes little difference to the red colour of the blood, and it doesn't take that much to discolour a river for a kilometre or more down stream.

Abattoirs usually do already collect most of the blood from the animals they slaughter. They dry it, and sell it as stock feed.

They collect the blood by first stunning the animal and then cutting the arteries in its throat while it hangs suspended from a conveyor over a trough or graded floor. The blood then runs down into a drain and is collected in a tank.

The problem is that a sizeable fraction of the blood congeals on the killing floor on contact with air. This congealed blood builds up and has to be washed away at frequent intervals. Usually these washings pass down the same drain as the liquid blood, but are diverted into the effluent stream, rather than collected in a tank. This is what causes discolouration of rivers or sea close by abattoirs that don't have secondary treatment facilities.

Stopping the blood from getting into the effluent is the obvious answer, but the extra return gained from collecting all the blood and selling it as stock feed may not cover the cost of installing more efficient blood-collecting equipment.

Mr Graham and Mr Neil McPhail of the Meat Research Laboratory have been following a line of research that may help. They have been looking into techniques now in use in Europe for collecting blood so that it can be used for human consumption. The idea may sound unpleasant, but whole blood contains an excellent assortment of amino acids, and with treatment to remove its colour it could be used as a protein supplement. Such supplements command a high price, which could justify the added cost of more efficient and hygienic blood collection.

Health authorities do not permit the blood collected by the currently used method to be sold for human consumption because considerable bacterial contamination takes place. One of the European methods involves cutting the animal's throat in the usual way and then placing a collecting cone over the wound so that the blood passes down a pipe to a storage tank. The other uses a specially designed hollow knife, which is jabbed straight into the neck artery. Blood passes through the hollow blade into a pipe and thence to the storage tank.

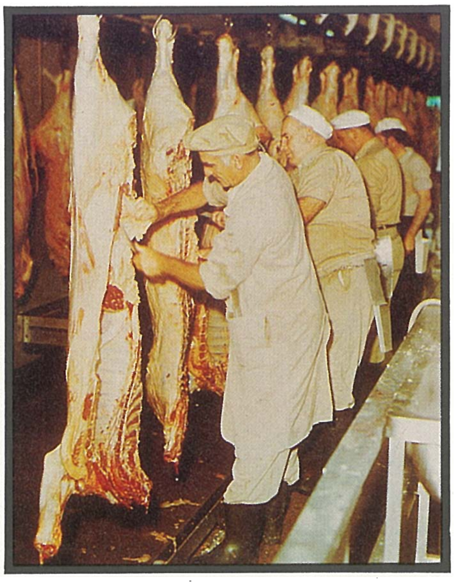
The researchers' tests, carried out in an abattoir of export standard under actual production conditions, show that the hollow knife allows much less bacterial contamination of the collected blood. However, it looks as though collecting all the blood from an animal will take too long for the method to be used in most of our abattoirs.

Because of the rate at which these abattoirs operate, only 1 minute can be allowed for bleeding the animal. Using the cone makes this possible, but it does allow greater, although probably still acceptable, bacterial contamination. Also rather more blood is spilt.

Either method would greatly reduce the amount of congealed blood accumulating on the abattoir floor, so the amount washed into the works effluent would be much less. Blood stored in the tanks is treated with citrate to prevent coagulation. Congealed blood does not therefore accumulate within these tanks, and only a fraction sticks on the walls and hence has to be washed off.

A problem with marketing whole blood for human consumption is its colour. Up to now, no cheap method has existed for taking out the red colour of the haemoglobin. Consequently, it has been necessary to separate the red haemoglobin-containing cells from the pale yellow plasma. In Europe, the separate fractions have then been dried and sold—the plasma as a colourless powder for human consumption, and the red-brown powder of haemoglobin for stock feed.

However, the powdered plasma makes up only about a quarter of the weight of the dried blood. So the collected blood



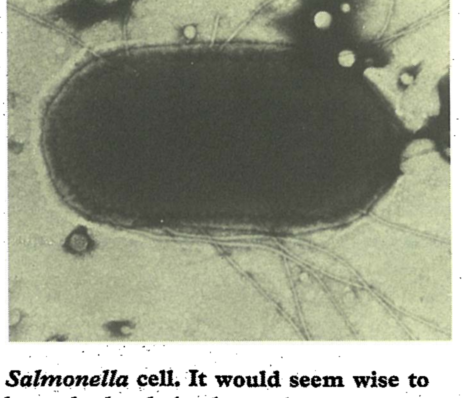
would be worth a great deal more if some inexpensive method of taking out the colour of the haemoglobin could be found. CSIRO has recently filed a provisional patent application on a process that should be able to do this at a reasonable price. It was developed at the Division of Chemical Engineering by Mr Alan Whitehead and Mr Bruce Wilson.

The process uses the fact that the proteins of blood are precipitated when the blood is added to acidified acetone. At the same time the haemoglobin molecule splits in two and its colour disappears. A white powder of blood protein is the end product. The acetone is recovered and re-used.

Tracking *Salmonella*

One other aspect of meatworks effluents —the *Salmonella* bacteria they contain— has been receiving attention at the Meat Research Laboratory.

Salmonella bacteria cause food poisoning—nausea, diarrhoea, vomiting, and a mild fever that may last as long as 3 days. Modern manufacturing methods like bulk processing have aggravated the *Salmonella*



***Salmonella* cell. It would seem wise to keep the levels in the environment as low as possible.**

problem by enabling small numbers of these bacteria to contaminate large quantities of food, which may then be exported from one country to another. Foods of animal origin are the most common sources. Cargoes of beef from Australia and elsewhere have been refused entry by several countries from time to time because of *Salmonella* infection.

In a study aimed at finding out where the infections came from, Dr Fred Grau and Mr Max Smith checked the *Salmonella* status of cattle at all stages between leaving the farm gate and slaughter. It appeared that most infection happened in sale yards, rail trucks, and particularly in the abattoir holding yards. *Salmonella* from the few infected cattle leaving the farm were surviving in the soil in the yards and infecting clean cattle.

A further survey of 10 city and country meatworks in Queensland and New South Wales also turned up two rather unexpected cases where *Salmonella* from the abattoir effluent were contaminating drinking water in the holding yards. Thus the bacteria were being recycled through clean stock.

The effluents from all 10 abattoirs surveyed were either discharged into nearby rivers or else irrigated onto lucerne crops or grass pastures—both places where *Salmonella* are now known to survive. Dr Grau and Mr Smith detected the bacteria in all creeks and rivers close to the outfalls.

Where only primary treatment was carried out, levels of *Salmonella* averaged between 24 and 1500 bacteria per millilitre—one sample contained 10 000 per millilitre. Using secondary treatment ponds considerably reduced the numbers —to between 0·04 and 8 per ml.

Nobody knows what effects, if any, these bacteria in meatworks effluents are having on human health. However, *Salmonella* do cause food poisoning, and they are known to survive in rivers and on pastures. This does not mean that adding to the low levels already in the environment will cause food poisoning, but it would seem wiser to err on the safe side and avoid spreading these bacteria around.

More about the topic

Blood collection and processing for edible purposes. A. Graham and N. G. McPhail. *CSIRO Meat Research Report* No. 4/74, 1974.

Salmonellae in abattoir effluents. M. G. Smith and F. H. Grau. *Australian Veterinary Journal*, 1974, **50**, 410–12.