Ammonia strippers on trial

People don't like scummy blooms of algae in their lakes. Often they become particularly incensed if sewage coming from towns up-river causes the blooms.

Of course it's nutrients in the sewage that allow the blooms to form, and Australia's high summer temperatures and erratic rainfall make its lakes and reservoirs particularly vulnerable to such blooms.

Partly for this reason, and partly because mining settlements in arid areas may one day have to contemplate actually drinking their own purified effluents, a team of scientists from the CSIRO Division of Chemical Technology has been looking at ways of producing very clean water from sewage.

The team has gone for physical and chemical processes to do the job rather than the conventional biological ones, and to gain experience it built a South-African-designed pilot plant at Lower Plenty, a Melbourne suburb (see *Ecos* 3).

Much of this pilot plant worked well. However, as elsewhere, problems arose in the nitrogen-removal system once the temperature fell below about 10°C.

Most of the nitrogen in sewage arrives at the treatment works as ammonia. Conventionally, allowing the effluent to stand in ponds lets algae and bacteria remove a proportion of this ammonia before the effluent is released into the sea or a nearby river. However, there are limits to how much ammonia such methods can remove.

Accordingly, most experimenters investigating systems for producing very clean water have favoured ammonia-stripping towers as a not-too-expensive alternative. Other ways are also effective, but usually cost a lot to run.

In such towers, effluent containing ammonia passes downwards over the surface of some form of packing material against a strong upward current of air. Under these circumstances, the dissolved ammonia should pass out with the air as ammonia gas. The packing is designed to increase the contact between the water and air passing in opposite directions.

The system works well in warm weather, but its efficiency drops off badly once the temperature drops below 10°C. So the towers don't work well in winter.

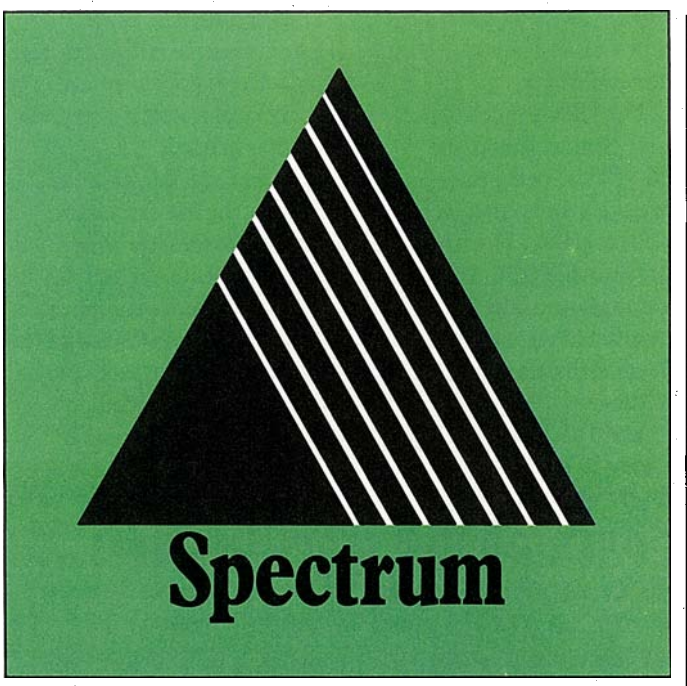
Perhaps the most thorough investigations into ammonia-stripping towers have been carried out at South Lake Tahoe in California. There, most of the experimental towers have contained a packing of wooden slats. Unfortunately, these slats have become scaled very quickly, and no cheap and satisfactory way seems to have been found to clean them.

The scaling problem arises from hydrated lime added to the sewage liquid to precipitate out most of the phosphate, colloidal organic matter, and heavy metals.

Mr Yen Ip and Mr Bill Raper, of the Division of Chemical Technology, have looked into using spray towers without packing, and they think that they have solved both the scaling problem and the one of operating in winter.

As a result of their research, Mr Ip and Mr Raper consider that it's possible to achieve any desired level of ammonia removal at air temperatures as low as 3° by using several unpacked spray towers placed in tandem. Mr Ip's costings suggest that such a system would indeed be economically viable if very clean water were desired.

At Lower Plenty, the two scientists set up an experimental spray tower



made of angle-iron cladded with asbestos sheeting. By constructing their tower so that the water-inlet nozzle could be set at 0·9, 1·8, or 3·7 m above the air inlet, they were able to use the one experimental rig to test the efficiencies of what were in effect three different sizes of tower.

Perhaps not surprisingly, they found that within a single tower the efficiency of transfer could be improved by adjusting the ratio of liquid to air, or by increasing the height of the tower. In addition, they found that a single unpacked tower equipped with suitable nozzles can remove up to 50% of the ammonia in waste water regardless of the atmospheric temperature.

Of course, 50% is not enough. A single tower containing packing can do considerably better than this. Even a very disappointing packed stripping tower installed by the Orange River County Water Department near Los Angeles achieved 65% removal (although not at low temperatures).

Next, the two scientists tried recycling their waste water through their tower several times. They did so during winter, when the air temperature varied between 0° and 5°C.

They tried this recycling at all three possible nozzle heights, but found the highest one, 3·7 m, to be the most suitable. The table shows how much ammonia each recycling

Likely costs of removing ammonia

stage number	cumulative ammonia removed (%)	cost (cents per 1000 litres)
1	45	0·8
2	70	1·7
3	83	2·5
4	91	3·3

The table shows Mr Ip's estimates of how much it would cost to pass waste water through each stage of a system of four spray towers. Removing 91% of the ammonia is not prohibitively costly.

through the 3·7-metre tower removed, and how much each one would cost.

The scientists calculated these costs as though the effluent was being passed through a different tower at each recycling. Thus the figure for removing 91% of the ammonia would be for passing the effluent through four identical towers in quick succession.

A cost of 3 cents per 1000 l for stripping 91% of the ammonia from effluent using successive spray towers may not be prohibitive if very clean water is needed.

In general, the scientists believe, the low capital and running costs of the simple spray tower compared with those of the more complicated packed stripping towers will offset the fact that four spray towers may be needed to do the job of one packed tower. And the fact that the towers can operate efficiently during winter makes ammonia stripping a viable proposition.

Incidentally, one possible snag with such strippers is that the ammonia stripped from the sewage is released into the atmosphere. The South Lake Tahoe installation in particular has run into criticism for this reason. However, measurements of ammonia concentrations in the air at that installation have always shown them to be below the limits set by the United States Environmental Protection Agency.

Ammonia stripping by spray towers. S. Y. Ip and W. G. C. Raper. *Proceedings of the 7th Australian Waste Water Association Convention Canberra 1977*, 1977.