Sludge disposal

Zurich's search for the ideal solution to sludge disposal

By Jürg Wiesmann

Zurich's quest to find an environmentally sound way to dispose of its sludge has been fraught with difficulties, but it now thinks it has found the answer to its problems.

Up until the mid-1980s, Swiss environmental legislation concentrated primarily on the protection of water. It is only in recent years that clean air and soil protection have become the subject of detailed legislative measures, now that dying forests, depletion of the ozone layer and the discovery of sites contaminated by earlier activities have forced politicians into action.

This upsurge of interest has had a decisive impact on all activities associated with the disposal of wastewater and sewage sludge. New laws may have served to strengthen the public's environmental awareness, but plant operators still have the problem of disposing of sewage sludge and some residuals will always have to be released into the environment. The daily volume of wastewater flowing into Zurich's treatment plants is such that the sludge produced cannot be stored.

Faced with the prospect of being forced to find new disposal methods, Zurich's wastewater authority decided to investigate the options available. After many setbacks it has settled for two disposal routes that will solve its problems for at least the next decade.

Until ten years ago, Zurich used to spread its pasteurized, digested liquid sludge on farmland. Two sludge filter presses were available to cope with emergencies.

When the Swiss water protection law of 1972 made it compulsory to upgrade existing plants to include biological treatment and phosphorus removal, the volume of sludge increased dramatically. It became increasingly difficult to dispose of sludge in the same way without breaking the regulations. Runoff from overloaded fields frequently polluted surface waters, nullifying the effort to protect them that had led to the original legislation.

In an attempt to overcome these circumstances, the government adopted a Sewage Sludge Ordinance in April 1981. Its purpose was to reduce the amount of sludge used in agriculture to a sensible level of 3t dry matter/ha[2] and impose seasonal restrictions.

A second option, landfill, became available to Zurich's wastewater treatment plant with the installation of two dewatering centrifuges. One drawback was that Zurich itself had no landfills and had to rely on sites elsewhere. Of these, only one operator was willing to take Zurich's sludge.

Unfortunately the wastewater authority had no control over the technical systems used on the site or the way in which the sludge was dumped. The high costs involved also meant that the operator had little interest in measures to combat the problems of waste gases and leachate.

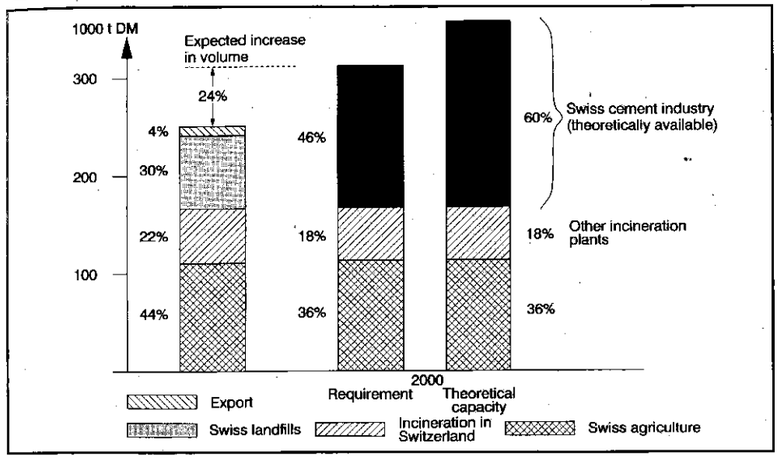
What triggered the real disposal emergency in spring 1988 was when the local council responsible for the landfill site suddenly banned Zurich from dumping any more sludge. Enquiries to find somewhere else in Switzerland to dispose of 100 tonnes a day of dewatered sludge proved fruitless, as 1986 national waste management guidelines now limited the dumping of sludge that had not been incinerated.

A decision was taken to expand Zurich's existing sludge treatment facilities (pasteurization, digestion, dewatering) as quickly as possible by constructing a sludge drying plant. A two-stage indirect drying unit was installed and began operating in the winter of 1989. Its output is a product with 90% dry matter content. The wastewater authority can now store the sludge through the winter and cope with seasonal demand from farmers. If covered, it can even be stored for several years.

Drying solved Zurich's immediate sludge problem, but agricultural use remains the main disposal option, and efforts are being made to improve its quality as a fertilizer. Since 1970 effluent controls have been imposed on industrial concerns to limit heavy metals and other contaminants that would prevent farmers using sludge. Levels of mercury, cadmium, zinc and lead are now well below recommended limits and further improvements may be possible.

Campaigns have also been directed at the public to educate them about the hazards of disposing of household chemicals and waste materials to the drainage system. However, new products containing low biodegradability substances with unknown long-term effects (such as phosphonates, tensides and EDTA) are constantly being manufactured. Experience has shown that as soon as there is the slightest doubt about a substance in sludge the media will rush in to cover the latest 'scare story'.

Temporary storage pavilion at Werdhölzi treatment plant used for dewatered sludge after closure of the landfill site.



Sewage sludge produced in Swiss wastewater treatment plants and its disposal. The cement industry has the potential to use all the sludge marked for incineration.

Such reports disconcert farmers, whose immediate reaction is to abandon fertilizers containing sewage sludge. As farmers are not obliged to take sewage sludge products, this particular disposal route remains fraught with a degree of uncertainty that it would be foolish to underestimate.

Moreover, a phosphorus balance drawn up for Swiss farming shows that there would be no need for either commercial or sewage sludge-based products as phosphorus fertilizers. The phosphorus content of farmyard manure is sufficient to supply all that plants are capable of assimilating. According to the amended Swiss law on water protection (1991) priority should be given to manure originating on the farm itself. Should there be any additional need, preference would then be for waste products (sewage sludge), followed by commercial products.

As a result, sales of commercial fertilizers have slumped. Some manufacturers have expressed an interest in a cooperative venture with Zurich wastewater authority to produce a low-priced phosphorus fertilizer based on sewage sludge. A number of such products are currently being market-tested, both for farmers and residential gardeners.

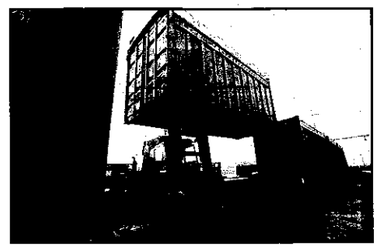
With such an uncertain future, Zurich still needed a second disposal route capable of coping with all the sludge if an emergency arose. Using dried sludge as fuel in the production of clinker (fused ash or slag) for the cement industry offered one possibility. A three-year nationwide study confirmed the benefits of the process as:

- complete elimination of all toxic organic compounds due to high combustion temperatures (>1000°C);
- heavy metals become bonded to the cement clinker during manufacture such that they cannot be leached out;
- savings in both coal and parent material;
- reduction in CO_2 through the replacement of imported coal, given that the biomass in the sewage sludge would have decomposed to CO_2 anyway;
- no problems in disposing of slag and ash, since the residuals have become part of the cement clinker.

The only drawback found was that there was no adequate flue gas cleaning equipment for filtering out mercury in the sludge.

In order to ensure that the quality of the cement does not suffer, dried sludge can only be substituted for coal for 5% of the tonnage currently fired. Despite this qualitative limit, it should, in theory, be possible to find all the incineration capacity for Switzerland's sewage sludge (150,000 t/yr) within the domestic cement industry.

The city of Zurich decided to give its full backing to this form of disposal as it was also attractive in terms of costs. A special separation unit was planned at its Werdhölzi treatment works to remove mercury from dried sludge. Environmental impact assessments gave the process a positive report and negotiations with the cement industry were well underway, when a sudden public backlash against the possible mercury problems and a 'not in my back yard' attitude to taking the sludge forced the project's abandonment.



Sludge being loaded for shipping.

These events demonstrate once again how difficult it is to have to try to solve a waste problem outside the actual catchment area of those who create it. They also show that even a project that is optimal in terms of environmental and process engineering can founder on political grounds.

Searching for yet another solution, the wastewater authority proposed incinerating the sludge inside Zurich's boundaries. Once again it proved impossible to convince the politicians to give the green light for the necessary detailed planning, even though none of them was able to come up with any sort of alternative.

After all this, the only secondary route left for disposing of sewage sludge was to export it. However, this contradicts the Swiss waste management guidelines, which call for waste products to be disposed of domestically, and as near to their point of origin as possible.

Waste exports are not without problems themselves. High disposal costs often result, not only from the outlay on transport and processing. Rarely are people who delve into such transactions qualified specialists with a concern for the environment; often they are people with a network of 'contacts'. Under these conditions it cannot entirely be ruled out that bribes will be paid. Unfortunately, one such case is exercising us in Zurich at present.

Even with correct handling, the export of sludge can only be a short

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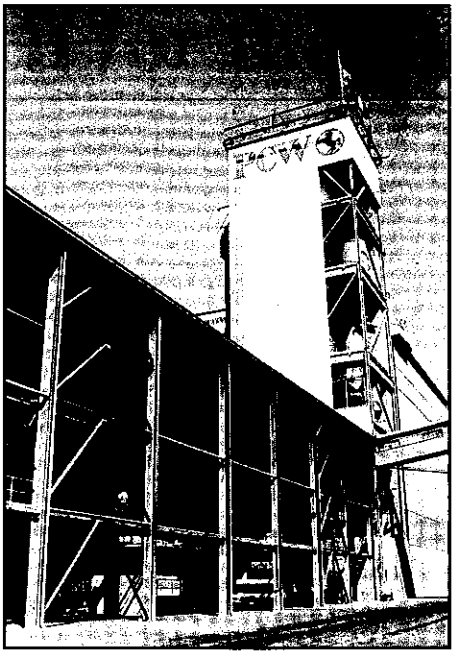
term option if we look at the disposal situation in other countries. Swiss sludge is currently exported to France and the UK. These countries are subject to the EC urban wastewater directive which will force the upgrading and building of treatment plants. Any additional sewage sludge that results will also have to be disposed of at as low a cost as possible, probably through farming. Politicians in these countries will be under pressure to ensure that potential takers use domestic rather than foreign sludge.

Having established that exports could not be considered as the reliable secondary disposal route, the search continued. A breakthrough came after negotiations with a different cement works. The installation of an extra activated carbon filter to clean flue gases would be paid for through charges to sludge suppliers using the facility. Flue gases would be cleaned to standards better than those laid down in the clean air regulations, overcoming the public objections that had defeated the first attempt to use the cement industry for sludge disposal. CO_2 emissions would also be reduced with the substitution of sewage sludge for hard coal.



Cement factory where Zurich's dried sludge will be burned in future.

After many setbacks, the city of Zurich believes that it has now solved its sewage sludge problems for at least the next ten years. The procedure that sets out to close the natural cycle by using sewage sludge as a fertilizer in agriculture is complemented by a back-up process that is both reliable and ecologically sound.

Time can now be spent researching the optimum use of sludge in agriculture, knowing that there is no binding necessity to dispose of it this way. It is even possible to work with industry and academia to analyse other techniques that exploit valuable substances contained in the sludge. Pyrolysis, for instance, would yield oils and gases that could be used as feedstocks for the chemical industry.

Implementing new solutions will take a long time. Also, we are going to have to recognize that in a country like Switzerland, where the active involvement of the general public is a very important factor, it is not going to be possible to solve a problem even with a solution that is technically excellent, unless at the same time it meets with the acceptance of the various public bodies concerned.

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