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National Meat Industry
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MINTRAC Scholarship Program

Using biological methods to improve the quality of effluent discharge from abattoirs

The problem

Abattoirs need large amounts of water for cleaning and to maintain hygiene, and this in turn results in large volumes of nutrient-rich effluent being produced. Technologies to achieve significant improvement in effluent quality (even to the point of making it suitable for re-use) exist but are expensive, both to construct and to operate. After initial screening and filtering, effluent is normally discharged into anaerobic fermentation ponds, and then applied to land to fertilize grain or forage crops. This method is an economical solution but has problems of its own. After treatment in anaerobic fermentation ponds, abattoir effluent still contains high levels of nitrogen (100 to 250 mg/L) and phosphorus (20 to 50 mg/L) and so only limited amounts can be sprayed on a given area of land – which has to be set aside for this purpose. Secondly, phosphorous is only taken up by plants at a fraction of the rate of nitrogen, and so may build up in the soil over time. And of course the loss of these nutrients represents a loss of potential income to the processor.

A proven method for producing high quality water from effluent is the use of natural or man-made, shallow lagoon systems that utilize aquatic plants to "capture" nutrients. Such systems have been employed for cleansing treated and untreated domestic sewage in the United States and around the world. An added advantage of this technology is that the plants, which are an intrinsic part of the system and are responsible for much of the nutrient being recovered, can be harvested to provide a valuable source of animal food or compost. However attempts to adapt shallow lagoon systems to deal with the much higher levels of dissolved nutrients and other pollutants such as fats and suspended solids, which are present in animal production systems, have met with mixed success.

So, in order to provide a useful solution to industry that would satisfy environmental concerns and produce a product of some economic value, our challenge was to find plants that:

- have the ability to tolerate high levels of dissolved nutrient
- are good accumulators of dissolved nutrient
- are acceptable as animal food, or possess some other characteristic with economic value
- have low-moderate potential as an environmental weed
- require little maintenance.

Other research has suggested that floating aquatic plants called duckweed may prove useful as a water cleanser and a site for nutrient accretion. During our initial trials, our attempts to grow duckweed were unsuccessful and disappointing. We thought that the reason for the death of duckweed placed in full-strength pond effluent may have been the very high levels of free ammonia present and we set out test to this, by the addition of acid and bentonite in various combinations to various media.

The results

The findings from several of these trials indicate that duckweed will grow vigorously on diluted (25%) effluent from abattoirs anaerobic fermentation ponds, and in doing so makes a substantial contribution to water quality, with nitrogen levels at the end of the period approaching that of secondary treated domestic sewerage. It would be expected that this could be further improved upon with a longer treatment time, suggesting that this technology would work well in a multi-stage lagoon system.

Laboratory analysis of the harvested plants suggest this material has potential for a high quality animal feed, with Crude Protein content approaching that of expensive protein supplements such as Soybean Meal. Harvesting and sale of this material may more than offset the costs of establishment and maintenance of such systems. Compliance with stricter EPA standards, and land freed up for production instead of being set aside for effluent application would only enhance profitability under these circumstances.

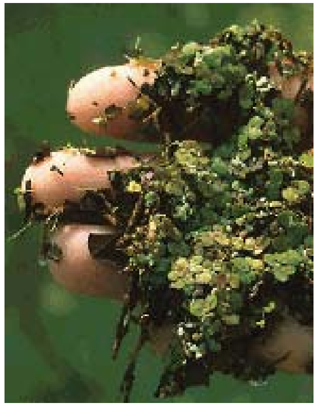

Illustration of duckweed

Where to next?

The nature and scope of this project was such that time and money did not allow further exploration of the potential of technology. Yet enough work has been completed to point the way toward commercial use of this method of improving abattoir effluent. The following prioritization is suggested to bring this technology into production:

1. Construction of a small, continuous flow system, which will mimic the dynamics of a multi-pond lagoon system (including determining optimal flow rates and harvesting regimes) to obtain the data necessary for the construction of a pilot scheme

2. Further investigation into water and plant bio-safety issues facilitating exploration of the uses to which the much-improved effluent and the harvested plant material can be put.

3. Exploring ways of processing plant material to make handling and transport more economical, such as harnessing excess capacity in blood and bone plants

4. construction and testing of several pilot (1/5th) scale systems on site, utilising the information gained from 1 above.

It is suggested that following this programme could lead to the technology being fully functional, and commercially "on-line" in 3-6 years. Operating systems of this nature should produce considerable benefits, primarily in reduced operating and capital costs, and its ability to satisfy environmental standards at relatively low costs.

John Goopy, conducting his research

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