The Design and Operation of Sewage and Industrial-Waste Treatment Processes

By C. H. KHADILKAR (*Public Health Engineering Division, Institution of Engineers, Poona-4, India*)

The existing Pasveer type of oxidation ditch has been modified and moderated, and named the B.O.D. ('Biological Oxygen Demand') Moderator, at about one-fourth of the original cost. In this modified process the ditch is first filled with water and aerated by means of rotors for 20 h a day. On the next day 10% of the water is removed from the aeration channel and an equal volume of raw waste is introduced into it. It is again aerated for 20 h. This procedure is continued for 5–6 days. At the end of this period the total volume of the waste added to the channel is 50% of the total volume in the channel.

On the fifth or sixth day a floc develops in the channel. This floc is examined under the microscope to ensure sufficient development of species of *Vorticella*, *Epistylis* and *Zoogloea ramigera*. The occurrence of these organisms indicates the 'ripening' of the ditch. After the 'ripening', the ditch is commissioned for continuous operation, and purification is obtained with a detention period of only about 6 h, as against Pasveer type of oxidation ditch where 24 h is required.

The detention time in this new method is further cut by feeding the channel with activated sludge prepared in a small activated-sludge unit.

This process is more suitable for the developing countries, where cost is a major factor in installing the customary treatment plants.

Decrease of the Bacterial Content in Different Types of Oxidation Ponds

By N. M. PARHAD and N. U. RAO (*Central Public Health Engineering Research Institute, Nehru Marg, Nagpur-3, India*)

Among the various treatment processes for sewage, oxidation ponds deserve primary consideration in India because of the abundance of light and suitable temperatures, in addition to other advantages such as cheapness in construction, simplicity in operation and ease of maintenance.

Though considerable work has been done in India and elsewhere on the performance of oxidation ponds with respect to the removal of biochemical oxygen demand, very little information is available on the decrease of indicator bacteria in different types of ponds. Four oxidation ponds of different designs located at Nagpur city (India) were studied. Samples were collected and analysed for standard plate count, coliforms, *Escherichia coli*, enterococci and biological oxygen demand.

From the results it appears that the mode of operation and the length of liquid travel are very significant, in addition to the loading, detention period and other design criteria. Of the four ponds studied, the one with three cells operated in series gave the highest percentage decreases of indicator bacteria and biological oxygen demand.

Rise of pH in Oxidation Ponds

By SHIVA S. RODGI, V. V. KANABUR, G. B. DODAKUNDI and H. S. PATIL (*Department of Zoology, Karnatak University, Dharwar, India*)

Laboratory experiments were conducted by inoculating the following media with a species of *Scenedesmus*: (1) autoclaved sewage; (2) a mineral medium containing CaCl_2 , MgSO_4 , KH_2PO_4 , NaHCO_3 and micro-nutrients, namely $\text{Co}(\text{NO}_3)_2$, NiSO_4 , CuSO_4 , FeCl_3 , H_3BO_3 and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$ supplemented with NH_4Cl or NaNO_2 or $\text{Ca}(\text{NO}_3)_2$; (3) this mineral medium without NaHCO_3 . The influence of temperature, algal population, alkalinity, bicarbonate, phosphate, ammonia N, nitrite N and nitrate N on pH variations in these three media was studied.

When the light-intensity was high there was a more striking increase in media (1) and (2) to pH 11.3, whereas the pH was only 9.6 in medium (3). The sterilized sewage supported more algae, about three times more than that in medium (2) and about nine times more than that in medium (3). The values for dissolved O_2 , phenolphthalein alkalinity and also the percentage decreases of bicarbonate, phosphate, ammonia N and nitrite N in medium (1) were comparable with those in the medium (2). With medium (3) the values for these items of analysis were much less than those in media (1) and (2).

These results suggest that bicarbonate appears to be a major factor influencing the pH fluctuations in the oxidation pond.

Treatment and Utilization of Wood-Hydrolysate Wastes

By G. J. MOHANRAO, P. V. R. SUBRAHMANYAM and M. V. SRINIVASAN (*Central Public Health Engineering Research Institute, Nehru Marg, Nagpur-3, India*)

An anaerobic process has been developed for the treatment and utilization of organic industrial wastes such as those from wood hydrolysis and pulp and paper mills. This anaerobic process removes 60–90% of the biodegradable organic matter. In tropical countries, as in India, with water temperatures in the range 20–30°C, anaerobic lagooning has been found

to be an ideal process because of its low capital and running costs and simple method of operation.

Anaerobic digestion of the wood-hydrolysate waste containing as much as 50% of pentoses (mainly xylose) among the sugars had posed a problem of sudden souring and failure of the digester when the detention time was decreased to less than 40 days. This was found to be due to the production of propionic acid from the oxidation of the pentose sugars. The fermentation of propionic acid to methane is limited to the species *Methanobacterium propionicum*. Where propionic acid is in large quantity in the medium, the numbers of these bacteria have to be boosted by artificial culturing or by providing a detention time of over 40 days for their natural multiplication. The anaerobic lagooning removed 90–95% of the biological oxygen demand from the wood hydrolysate when nitrogen, phosphorus and seed sludge were supplied in proper proportions.

The wood-hydrolysate waste from a rayon-grade pulp mill contained 5% total reducing sugars, of which 50% were pentoses. *Torula utilis*, a fodder yeast, was grown on this waste; 50% of the biological oxygen demand was removed and the yield of dry yeast was 10g/l of the waste. A good protein was thus made from inorganic nutrients and an industrial waste, simultaneously producing a valuable food material and reducing a water pollution problem. The mother liquor after recovery of the yeast was further processed by anaerobic treatment followed by aerobic treatment.

Stabilization of Waste Water Containing Phenols with Yeast-Enriched Activated Sludge

By B. VENKATA RAO and J. V. BHAT (*Department of Microbiology and Pharmacology Laboratory, Indian Institute of Science, Bangalore-12, India*)

Slow adaptation of activated sludge to phenol and catechol resulted in selective enrichment of the yeasts *Candida tropicalis* and *Trichosporon cutaneum*. The adapted sludge containing these species oxidized phenols efficiently and stabilized the sewage containing the phenols. Non-adapted activated sludge also, when supplemented with these yeasts, acquired the ability to degrade the phenols rapidly. Addition of nitrogenous and phosphatic nutrients, however, was essential for maintaining continuous and efficient operation with the adapted sludges. Urea and KH_2PO_4 were found to be suitable for maintaining a healthy activated sludge, the proportions of nitrogen and phosphorus that are essential for its efficient functioning being 1:80 for N/COD and 1:400 for P/COD. The possibility of using these yeasts for removal of phenols from industrial wastes is suggested.

Treatment of Dairy Wastes by the Activated-Sludge Process

By C. A. SASTRY, G. R. KINI and G. J. MOHANRAO (*Central Public Health Engineering Research Institute, Nehru Marg, Nagpur-3, India*)

During recent years milk-processing units and dairies in different parts of India have increased and have also created the problem of treatment and disposal of the waste water from them. Experiments showed that these waste waters were amenable to treatment by the conventional activated-sludge process and by the contact-stabilization process. The results showed that a steady growth of sludge occurred from the beginning of aeration and that the volatile matter in the sludge increased from 61 to 87% in 27 days. About 0.66–0.73 kg of volatile suspended solids was produced/kg of biological oxygen demand removed (1 kg of biological oxygen demand is defined as the demand for 1 kg of dissolved oxygen by the micro-organisms in the process of stabilization of organic matter). The removal of biological oxygen demand was 98.5% at a loading of 0.75 kg of biological oxygen demand/day per kg of sludge solids. The optimum range for mixed liquor-suspended solids was 2000–3000 mg/l and the aeration period required was 6 h. In the contact-stabilization process the removal of biological oxygen demand was 87–89% and the contact and stabilization periods required were 40–60 min and 3 h respectively.

Control of Environmental Pollution Arising out of Industrial Wastes

By T. R. BHASKARAN (*Geo. Miller and Co. Private Ltd., New Delhi-49, India*)

With the rapid growth of population and technological advances, throughout the world an environmental crisis is developing that is affecting the wholesomeness and decency of the living conditions of the human population.

Waste products from industries are indiscriminately poured out into the air, the water and the land environment. The air around us is becoming polluted with dust, smoke, fumes etc. that are injurious to health. The thermal environment in some industries is also very uncomfortable for the workers involved. Poisonous substances, such as cyanides, arsenic and chromium, discharged through industrial effluents, make water dangerous to human, animal and plant life. Heavy organic pollution from paper factories, sugar mills, distilleries etc. render water obnoxious and unsuitable for the culture of fish. Pollution by industrial wastes also makes the water less useful for agriculture, industries, power development and navigation. The micro-climate of some regions is