CHAPTER - VII

ADVANTAGES OF USING HIGH-RATE AEROBIC OXIDATION PONDS

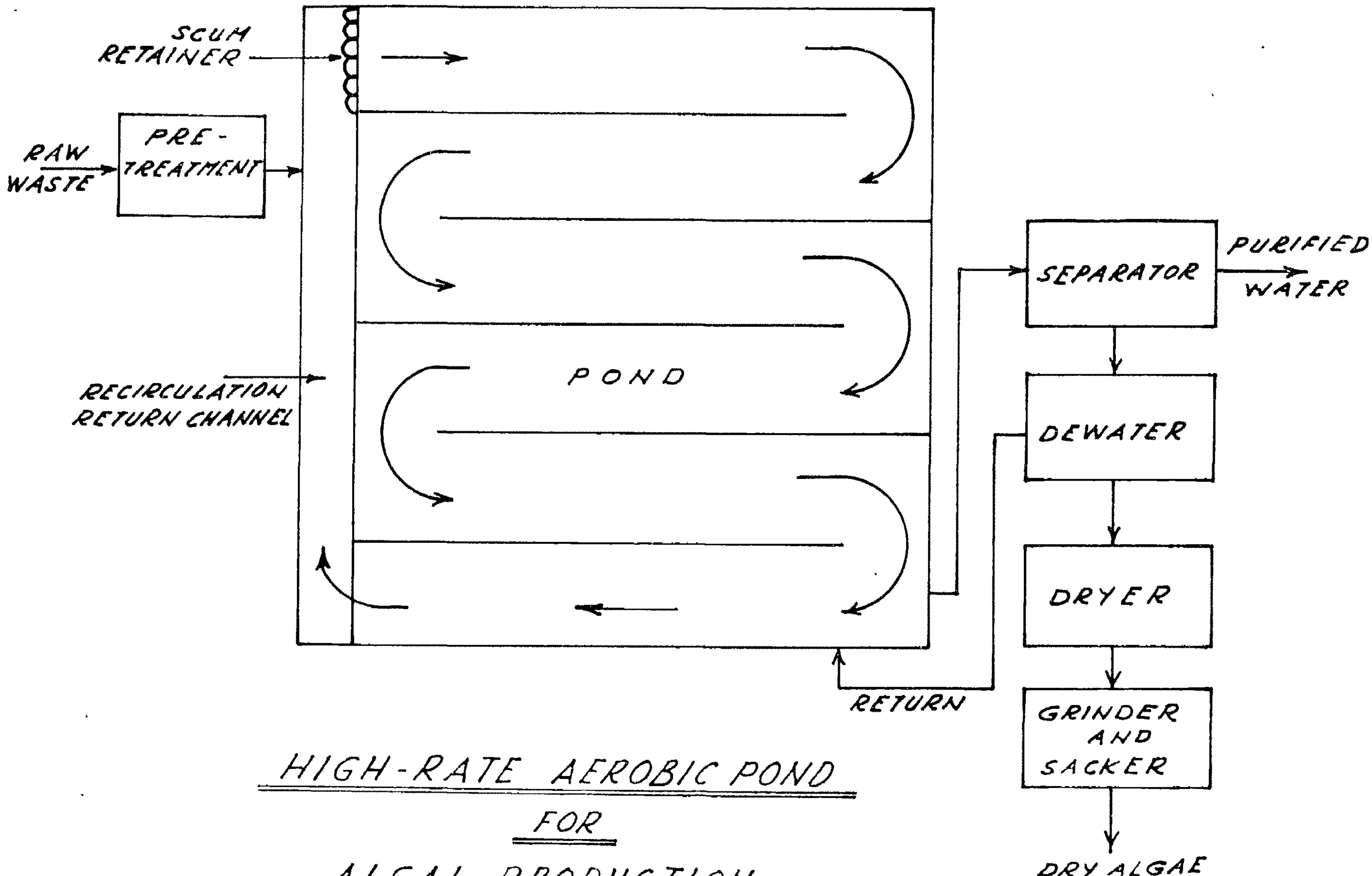
Man, the son of Adam and King of the universe since the dawn of the civilization, has been depending almost entirely on photosynthesis for his food, fuel and fibre. In his greed for power he has been exploiting the fossil fuels at such a fantastic rate that he is now forced to meet his energy needs by resorting to other sources of energy such as nuclear fission and through development of practical methods for fixing the almost inexhaustible supply of solar energy. But there are many practical problems to be solved before he can use fully nuclear fission. High capital costs, highly developed technology, a highly trained scientific personnel and the problem of atomic waste disposal are some of them. So, the only safe and economical process left for man for consideration is the fixation of solar energy through the primordial process of photosynthesis (Oswald and Golueke 1960).

Oswald (1962) has described the several advantages accruing from the use of a high-rate oxidation pond and they are given below:

Production of power from solar energy by means of algae:

Oswald and his associates have shown the possibility of fixing radient energy for large scale production of algal matter at very low cost. They have shown algae could probably be produced for digestion at less than $ 0.01 per pound in open, shallow and sewage fertilized high-rate aerobic ponds. So, the economic feasibility of using algae for fixation of solar energy appears to be within the realms of practical politics. Their early studies have shown that, although the production of methane from algae grown on a community's wastes may be technically and economically feasible, their later studies have indicated that some source of nutrient for the algae other than domestic sewage would have to be found to enable the process to supply a significant fraction, if not all, of the power requirements of a community. This led to the concept of introducing digester residue influents into the algal culture, thereby recycling the fertility elements and thus ensuring the energy fixing capacity of the ponds. Studies of the practicability of recycling digester residues were undertaken and it was found to be feasible on a laboratory scale (Oswald and Golueke, 1960). Thus a promising method for producing electricity from solar energy became available for evaluation.

Fig. 26



HIGH-RATE AEROBIC POND FOR ALGAL PRODUCTION

Production of cheap algal protein:

Large scale production of algae at the extremely low cost required to make economically feasible the production of power through algal digestion necessitates highly specialised pond design criteria. The development of these criteria was accomplished in a series of studies at the University of California over a period of a decade. Information gained from the laboratory and pilot plant studies at the University, together with that from the numerous excellent studies of algal cultivation in inorganic media carried out at other centres (Burlew 1953, Tamiya 1957) make it possible to define a number of clearly essential and fundamental operational criteria for the culture of algae in organic wastes, as shown in Fig. 26?.

Preventing eutrophication of receiving waters:

The older conventional methods of secondary sewage treatment like the activated sludge and the trickling filter processes produce effluents which produce uncontrolled multiplication of algae in receiving waters. But the effluents from high rate aerobic oxidation ponds, having produced one crop of algae in the ponds and their effluents thereby usually depleted of algal nutrients, will not produce a second crop of algae if admitted into receiving waters. The effluents from high-rate aerobic ponds are more ideally suited for discharge into natural waters in which algal growth has frequently been a source of nuisance.

<u>Helpful in softening hard waters:</u>

Hard waters containing a significant amount of salts of calcium and magnesium which constitute the major elements of permanent hardness, the method of high-rate aerobic oxidation pond may be used to bring about a significant degree of softening. The increase in pH resulting from vigorous algal photosynthesis causes the precipitation of $Mg(OH)_2$ and complexes containing Ca, ammonia ~~Am~~ and PO_4. Water softening is the result. About 50% of the permanent hardness may be removed in this manner.

<u>For establishing industrialised food production complexes:</u>

Oswald (1962) has visualised new possibilities of establishing industrialised food production complexes with unusual properties. He has shown one such hypothetical system schematically below:-

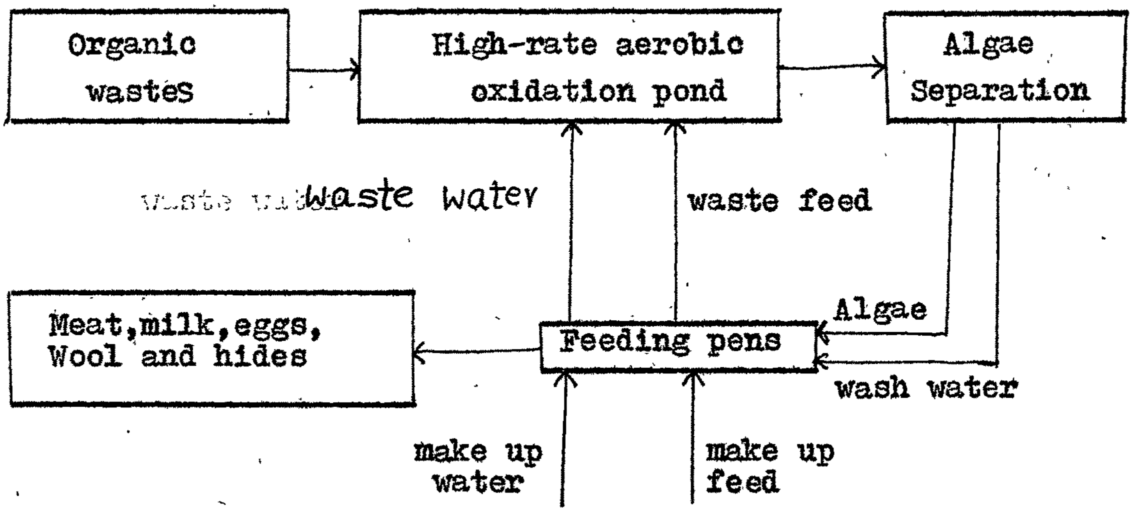


Fig. Animal Products Production Complex using High-rate Oxidation ponds and Closed Cycle conversion of organic wastes.

Organic wastes are diverted into shallow ponds in which algae are grown for harvest. Harvested algae, together with supplemented food, are fed to animals which in turn produce, meat, milk, eggs, wool hides and other products useful to man. All useful products are removed from the system and all wastes, such as urine, manure, wash water, meat trimmings and dressings are returned for biological conversion to algae and reuse in the cycle.

<u>Economics of nitrogen utilization in high-rate aerobic oxidation ponds and in conventional agriculture:</u>

In conventional agriculture 5 pounds of nitrogen are required to produce one pound of eggs and meat and 4 pounds are lost as waste. But in a controlled photosynthesis complex, 2 pounds of newly introduced nitrogen are combined with 3 pounds of reclaimed nitrogen to form 5 pounds of feed nitrogen. As in conventional agriculture, after feeding one pound of eggs or meat and 4 pounds of waste are obtained. However of these 4 pounds of waste nitrogen, 3 pounds are converted back to feed and only one pound goes to waste. Thus in such a problem producing complex, 50% nitrogen introduced into the cycle appears as useful products, whereas only 20% is converted into a useful product in conventional agriculture. Similar cycles could be shown for milk, wool and other animal products. According to Oswald (1962) computations show that 5 million acres of algal-animal cultures will meet the entire protein needs of the U.S.A., whereas 300 million acres are now required with conventional agriculture. The economics resulting from waste disposal and water reclamation by means of high-rate aerobic ponds would be the incidental benefits of such complexes.

Salvaging sea water for algal-protein:

In coastal towns sea water can be mixed with the town sewage or other organic wastes in high-rate aerobic oxidation ponds for producing dense crops of algae of various types which can be harvested for algal protein. In this way nearly a third of the sum total of fresh water resources can be diverted to purposes other than protein production.

Conclusion:

In brief researches to date on high-rate aerobic oxidation ponds carried out by Oswald and his associates in the University of California go to show that it is technically feasible "to treat wastes, to reclaim water, to render waste organic material suitable for use as an animal feed stuff, to obtain unprecedented yield of protein per acre of pond surface in either fresh or saline waters and to produce electrical power from Sunlight using organic wastes as a medium " (Oswald, 1962).