

CHAPTER - VII

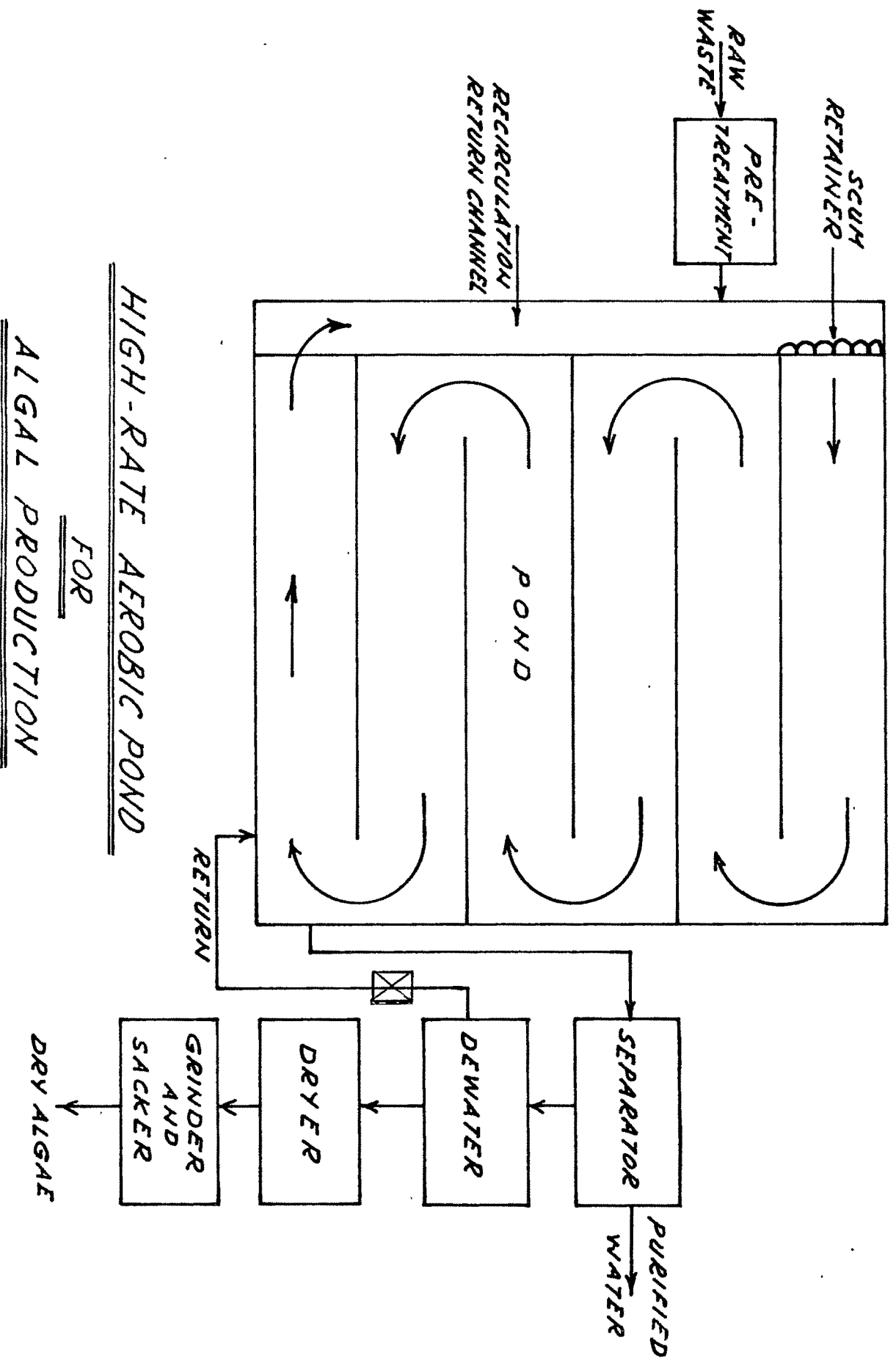
ADVANTAGES OF HIGH-RATE OXIDATION PONDS

Man, the son of Adam and King of the Universe since the dawn of 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).

- i) Production of power from solar energy by means of algae (Oswald, 1962):

Oswald and his associates have shown the possibility of fixing radiant energy for large scale production of algal matter at a very low cost. They have shown that algae could profitably 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 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 increasing the energy fixing capacity of the pond. Studies of the practicability of recycling digester residue 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 on a pilot plant scale.

Fig. 20



ii) Production of cheap algal protein (Oswald, 1962):
(Fig. 20).

Large scale production of algae at the extremely low cost required to make economically feasible the production of power through algal digestion necessitates highly specialized pond design and operation 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 those 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 operation criteria for the culture of algae in organic wastes.

iii) Preventing eutrophication of receiving waters:
(Oswald, 1962):

The older conventional methods of secondary sewage treatment like the activated sludge and the trickling filters 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.

iv) Helpful in softening hard waters (Oswald, 1962):

With 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 increased pH resulting from vigorous algal photosynthesis causes the precipitation of $Mg(OH)_2$ and complexes containing Ca, NH_3 and PO_4 . Water softening is the result. About 50% of the permanent hardness may be removed in this matter.

v) For establishing industrialised food production (Oswald, 1962):

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

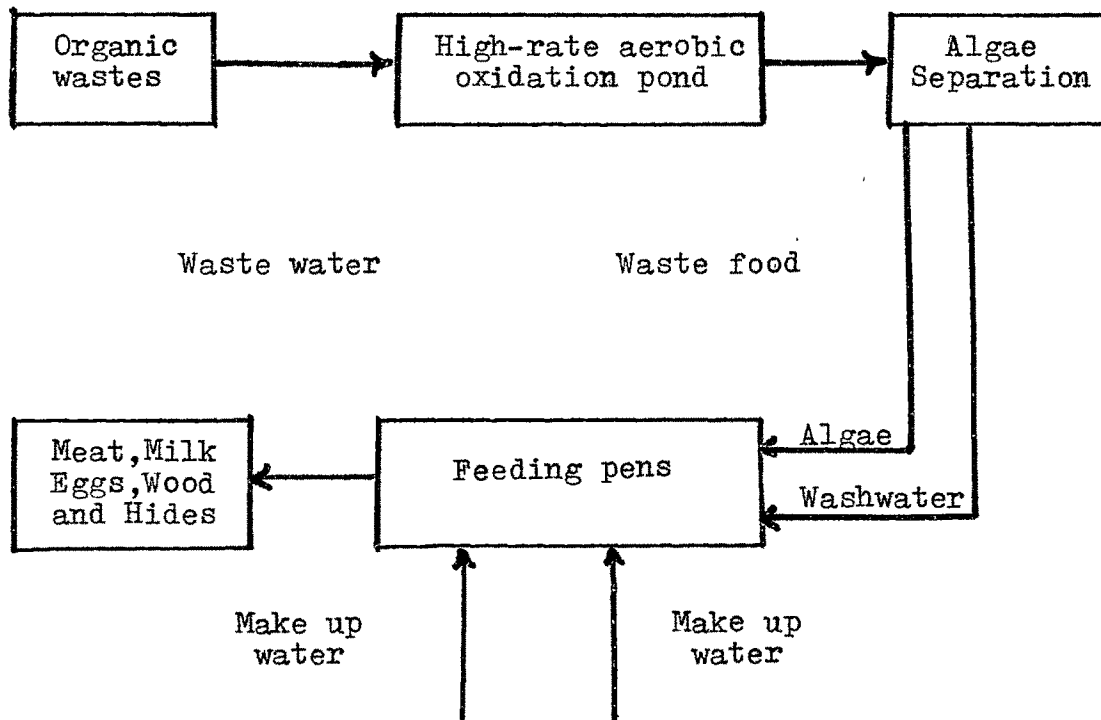


Fig. : Animal products production complex using High-Rate Oxidation Ponds and closed cycle conversion of organic wastes.

Organic wastes are diverted into shallow ponds in which algae are grown for harvest. Harvested algae, together with supplemental 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.

vi) Economics of nitrogen utilization of high-rate aerobic oxidation pond and in conventional agriculture (Oswald, 1962):

In conventional agriculture 5 lbs of nitrogen ■ are required to produce 1 lb of egg or meat and 4 lbs are lost as waste. But in a controlled photosynthesis complex, 2 lbs of newly introduced nitrogen are combined with 3 lbs of reclaimed nitrogen ^{from} ■ 5 lbs of feed nitrogen. As in conventional agriculture, after feeding 1 lb of egg or meat, 4 lbs of waste are obtained. However, of these 4 lbs of waste nitrogen, 3 lbs are converted back to feed, and only 1 lb goes to waste. Thus in such a problem producing complex, 50% nitrogen introduced into the cycle, appears as useful products, where as only 20% is converted into a useful product in conventional Agriculture. Similar cycles could be shown for milk, wood 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.

vii) Salvaging sea water for algal protein
(Oswald, 1962):

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.

In brief, researches todate 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 initial feed stuff, to obtain unprecedented yields 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".