Harvesting of Algae Grown on Raw Sewage

J.M.P VIVIERS and J.H. BRIERS
National Institute for Water Research, CSIR, PO Box 395, Pretoria 0001

Abstract

Harvesting of algae comprises three separate but interdependent process stages, i.e. separation, dewatering and drying.

An alga] production pond of 260 m^2 (0,4 m depth) was operated with raw sewage. Dissolved air flotation was used in conjunction with aluminium sulphate as flocculant to obtain a slurry containing 2 to 3% of dry solids and with a cationic polyelectrolyte a slurry containing up to 8% dry solids was obtained. The latter slurry showed superior dewatering characteristics in comparison with the alum derived slurry.

Pilot-scale tests have confirmed that photosynthetically produced oxygen, which reaches concentrations in excess of 20 mg *t'* during daylight hours, may be harnessed to effect spontaneous flotation, which may serve as a viable alternative to the dissolved air flotation technique. If this technique *is* combined with polyelectrolyte flocculation, the cost of separation, dewatering and drying can be reduced significantly. The quality of the final product is improved in terms of lower ash content.

The major harvesting costs are associated with the drying process *so* that overall costs can be reduced by improving the efficiency of moisture removal in the separation and dewatering stages.

Introduction

The ever-increasing demand on the world's food supplies has necessitated the optimization of production techniques and the establishment of fresh nutrient sources. The recovery of nutrients from waste effluents is but one alternative being investigated to ensure a continued supply of protein.

Feed products such as soya bean and fish meal, which compare favourably with traditional protein sources, may be supplemented by algal culture.

The National Institute for Water Research (NIWR) has been investigating the feasibility of algal culture iff domestic wastewater for several years. This paper highlights results pertaining to the definition and optimization of some of the engineering parameters which are important for the practical implementation of the process. The main emphasis is on the physical and chemical parameters involved in separating biomass from the growth medium, but general guidelines regarding hydraulic design considerations and cost aspects are also provided.

Experimental Facilities

Algae are cultivated at the Daspoort Experimental Station of the NIWR, Pretoria by introducing raw sewage (screened on a 6-mm wedgewire screen) into a 260 m^2 pond, which has been partitioned into meandering channels. The depth of the biomass in the pond is controlled at a specific value in the range 0,3 to 0,5 m. A flow velocity of about 12 m *s~1 is* maintained by means of a variable speed paddle wheel. The design and operation of the pond are similar to that of the intensive algal wastewater system being studied by Shelef, Moraine, Meydan and Sandbank (1976 and 1977). The sequence of harvesting from the pond to the final stages of product processing and a general outlay of the float cell used are shown in Figures 1 and 2 respectively.

The upward flow in the reactor zone (flocculation zone) of the cell is in the of del of 23 m h^{-1} while the downward flow in the clarification zone is about 4 m h-1, both at a design feed rate of *6 m3 h~'*. Algal float sludge is removed intermittently at preset time intervals (1 to 2 h) by means of chain-driven scraper blades geared down to move at 250 mm min-1. Air saturation of the recycled float cell effluent in the saturator vessel takes place at a pressure of approximately 450 kPa, the throughput ranging from 10 to 40 l min, depending on the recycle ratio.

Secondary dewatering of the concentrated algal sludge is effected by means of an 0,4 *mm* stainless steel wedgewire screen (2 000 mm x 500 mm . The dewatered algae are dried at approximately 120 °C by means of a double-toll steam-heated drum drier.

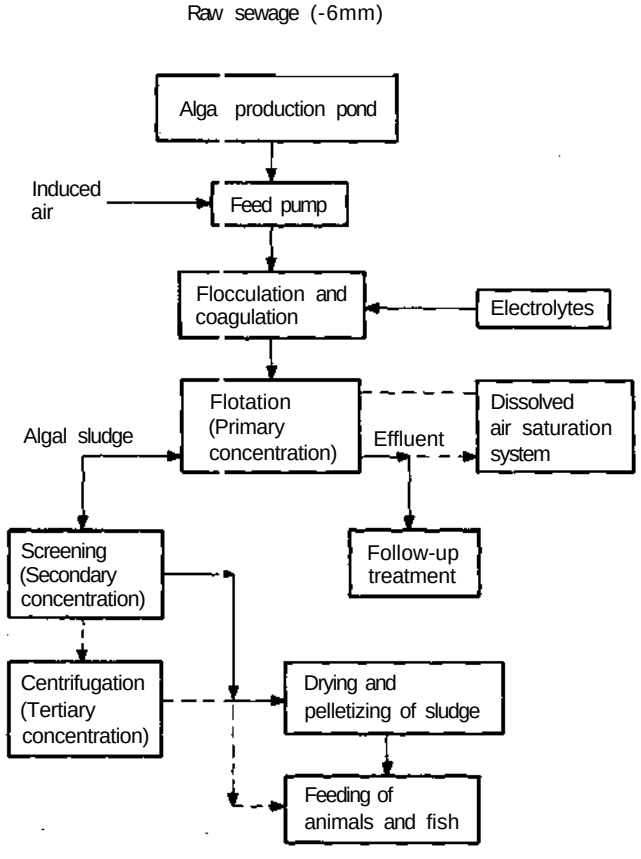

Figure 1
Flow diagram for biomass harvesting and processing