EXECUTIVE SUMMARY

BACKGROUND:

1. INTRODUCTION

The Water Utilisation Division of the University of Pretoria has developed a micro-screen method for the selective cultivation of essentially mono cultures of filamentous algae and fungi.

Because of the screening action of the micro-screen, it is possible to increase the biomass in a continuous culture of filamentous fungi to higher concentrations than what is usually achieved by other means. In general, higher concentrations of biomass means that smaller reactor volumes are required to effect a particular bio-mediated reaction.

Although there are advantages in by increasing the biomass concentration in a bioreactor, one serious disadvantage observed with filamentous biomass is that an increase in biomass concentration leads to a decrease in the efficiency of oxygen transfer in such cultures. Since oxygen is an essential (and costly) nutrient for aerobic biochemical processes, optimisation of oxygen transfer in filamentous fungi was identified as essential for the successful application of the micro-screen selective cultivation method for the treatment of some specific industrial wastewater streams.

This project deals with the development of improved cultivation techniques of filamentous fungi (growing on a fatty acid containing industrial effluent) with special emphasis on oxygen transfer in such biocultures.

2. OXYGEN TRANSFER IN (WASTE) WATER AND METHODS

A literature survey was made of the various methods used for determining the oxygen transfer rates obtainable from aeration devices. Aeration devices are usually tested under "standard" conditions and the benefit of these tests are that different aeration devices can be compared with each other.

The real test of aeration devices lies in its performance under "field" conditions. As it is rather difficult to test aeration devices under these conditions, the Standard test results are usually modified in an attempt to simulate field conditions. At best, this is only an approximation of the real situation.

In wastewater treatment, Chemical Oxygen Demand (COD) balances are used to determine the oxygen requirement of a particular biological wastewater treatment process. This same method, although very cumbersome, could be used to determine the oxygen transfer efficiency in a biological growth system. This was the method used in this study to determine the aeration efficiency under various experimental conditions.

3. EXPERIMENTS AND RESULTS

The experiments done can be classified as Background experiments and Aeration comparative experiments.

In the Background experiments conditions were established under which meaningful comparative experiments could be performed. A comparison of the traditional chemostat method with the newer auxostat method for the continuous cultivation of micro-organisms was made. The auxostat or pH controlled feed-on-demand method was found to be better for our purposes.

The auxostat method was then applied to two reactors in series operation. In this reactor arrangement, the first bioreactor supplies a constant concentration and physiological age of micro-organisms to the second bioreactor. Different experimental conditions are then superimposed on the second bioreactor and its effect measured. This arrangement works quite well.

The following aeration conditions were tested:

- The effect of mechanical mixing with diffused air aeration on oxygen transfer;
- The effect of air flow rate on oxygen transfer; and
- The effect of diffuser submergence on oxygen transfer.