The selective cultivation of the thermotolerant *Aspergillus* sp. on spent sulphite liquor

WA Pretorius* and GG Lempert
Department of Chemical and Environmental Engineering, University of Pretoria, Pretoria 0002, South Africa

Abstract

Spent sulphite liquor (SSL) from a pulp mill was evaluated as a potential source for single-cell protein (SCP) production. The lowering of the relatively high discharge temperature of the effluent as well as the removal of biologically generated heat could hamper the economics of SCP production. In this paper a description is given of the dynamic selection of a thermotolerant *Aspergillus* sp. that proliferates on SSL at 45°C and which has the potential of SCP production at elevated temperatures.

Introduction

In South Africa the temperature of municipal waste water generally varies between 10°C and 30°C (Water Research Commission, 1984). With a chemical oxygen demand (COD) of 500 to 800 mg-^', the heat generated during the biological purification process is less than the heat lost due to aeration (Eckenfelder, 1980). Except for compensating during the design phase for the rate limiting effects of temperature on nitrification in biological nutrient removal plants, no special attention is given to temperature in municipal waste-water treatment plants.

In contrast to municipal waste water, many industrial effluents have both high COD concentrations and temperatures. Values reported for sugar mill effluents were 1,5 to 2,0 g COD-l[1] at 45° to 70°C (SRK Inc., 1990a) and 18 to 26 g COD-l[1] at 45° to 75°C for paper and pulp mill effluents respectively (SRK Inc., 1990b). These effluents should either be cooled to ambient temperatures and below for ordinary mesophilic biological treatment, or special care should be taken to operate in the thermophilic temperature range.

The growth of filamentous organisms in relatively dilute effluents at mesophilic temperatures has been investigated as a possible process for the production of single-cell protein (SCP) (Pretorius and Hensman, 1984; Kuhn and Pretorius, 1988; Kuhn and Pretorius, 1989a; b). A comprehensive cost analysis on the full-scale production of SCP from petroleum waste water has indicated that the initial cooling of the effluent and the subsequent removal of biologically generated heat constitute a major part of the production costs (De Wet, 1992). Attempts to isolate a thermophilic filamentous micro-organism which could use this effluent were unsuccessful.

Pulp and paper mill effluents have been identified as a possible source for the production of SCP (Cloete, 1990). The chemical composition of this effluent is quite different from the petrochemical effluent. Since this effluent is also discharged at a temperature above 45°C, producing SCP from this effluent is also subject to the cost of cooling. It would thus be advantageous if an easily cultivable and harvestable thermophilic filamentous micro-organism suitable for SCP could be found for this type of effluent. The purpose of this research was to selectively cultivate, identify and evaluate thermophilic filamentous micro-organisms capable of utilising a pulp mill effluent for possible SCP production.

*To whom all correspondence should be addressed.
Received 23 April 1992; accepted in revised form 27 July 1992.

Pulp mill effluent

One of the major pulp mills in South Africa uses approximately 85% *Eucalyptus* and 15% wattle wood and the calcium-based sulphite pulping process to produce cellulose pulp. In this pulping process about 275 000 t of a lignosulphonated black liquor (known as spent-sulphite liquor (SSL)) is produced annually (Sappi/Saiccor, 1991). Typical chemical analysis of the undiluted effluent is shown in Table 1.

At the pulp mill the concentrated SSL is diluted with water from the washing and bleaching processes to give a final effluent with an organic content of 16 to 28 g COD-l' and a temperature of 45 to 60°C (SRK Inc., 1990b). This effluent is discharged at a rate of 80 000 m^3-d' into the Indian Ocean (Sappi/Saiccor, 1991).

TABLE 1
CHEMICAL COMPOSITION OF SSL (JURGENSEN AND **PATTON, 1979)**

Constituent	% of solids	Typical concentration g·ℓ'
Total sugars	15-22	93
Volatile acids (as acetic)	2 - 5	0-8
Lignin (as lignosulphonates)	50 - 65	354
Sulphur (all forms as S)	8-10	43
COD		160-230
BOD_5		25-80

Materials and methods

Selection reactor

A continuously fed reactor equipped with a crossflow-microscreen as described by Kuhn and Pretorius (1989b) and shown in Fig. 1 was used as reactor.