

Studies on biodegradation of vegetable-based fat liquor-containing wastewater from tanneries

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Abstract Fat liquoring, a post-tanning operation is carried out on tanned leather using oils, fats, or greases in emulsion form to make soft leathers and to improve the physical characteristics of the finished products during leather manufacturing. Around 10–15 % of un-exhausted fat liquor is discharged in the process water as wastewater. The major components of vegetable fat liquor are triacylglycerols, which primarily consist of glycerol molecules esterified with long chain fatty acids. The presence of fats, grease, and oils not only causes choking of wastewater conveyance mains but also interferes with the oxygen-transfer efficiency in aerobic treatment process. The aim of the present study is to assess the rate of biodegradability of vegetable-based fat liquor-containing wastewater generated from tanneries for various food to microbial (*f/m*) ratio, i.e., 0.35, 0.25, and 0.15 g biochemical oxygen demand (BOD_5)/g volatile suspended solids (VSSs) day. The *f/m* ratio and reaction time were investigated in detail in aerobic batch reactor to arrive at the optimum ratio needed for biodegradation of vegetable fat liquor. From the aerobic biodegradation studies, it was established that at an *f/m* ratio of 0.15 and a reaction time of 24 h, BOD_5 and chemical oxygen demand removals were 97.24 and

89.58 %, respectively. It was evident from Fourier transform infrared spectrometry and electrospray ionization–mass spectroscopy analysis that the triglycerides present in vegetable fat liquor were degraded effectively.

Keywords Biodegradation · Food to microbial ratio · Oil and grease · Vegetable fat liquor · Triacylglycerol

Introduction

Leather processing involves many chemical reactions and mechanical processes in converting the raw hide or skin of highly putrescible material into leather. Tanned leather which has not been treated with oils, fats, or greases in emulsion form will dry out hard and stick during the drying process. To avoid this problem and to produce soft leathers, fat liquoring is added as a step after the tanning process (Sarkar 2005). Fat liquoring, a post-tanning operation, involves incorporating fat, grease, and oils into the skin of the leather before the leather is dried. Fat liquor improves the physical characteristics of leather such as tensile strength, wetting properties, waterproofness, and permeability to water vapor and air (Santos and Gutterres 2007). Depending upon the source of the oils or fats used, fat liquor can be classified as vegetable, synthetic, and semi-synthetic fat liquors. In the present biodegradation study, vegetable fat liquor derived from different plant sources and mainly consisting of vegetable oils was considered. Vegetable oils are primarily water insoluble and to make them water soluble, these oils are sulfated/sulfited chemically using sulfuric acid during fat-liquoring process. The sulfited oils have smaller emulsified particles and have a higher capacity of bonding thereby increasing the affinity for the tanned fibers. Both sulfated and sulfited oils are

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