KARNATAKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY

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"COFFEE WASTE TREATMENT USING BIOREACTOR"

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ABSTRACT

India is one of the largest producers of coffee having 266,000 hectares of land under coffee cultivation. The coffee bean is obtained after the pulping process where the outer mucilage is removed and washed. This pulp makes up about 29% of the coffee cherry and hence a large amount of pulp and wastewater is generated during pulping process. The disposal of these wastes is generally neglected and no scientific methods have been adopted. This waste, along with causing serious pollution of soil and water also poses a problem of disposal due to its large quantity of production.

One the other hand there has been extensive exploitation of natural resources in the pursuit of satisfying the energy needs of a state which has resulted in the depletion of fossil fuels and escalation of fuel prices. Advances in environmental engineering and biotechnology have made it possible to harness bio energy through municipal solid waste as well as agricultural waste. Coffee pulp being an agricultural by product can be considered as an efficient source for bio energy. Anaerobic degradation process is one of the important methods adopted for treatment of waste. Also, anaerobic process taking place in certain controlled environment leads to the generation of bio-energy. These characteristics of anaerobic degradation process make it suitable for the treatment of organic waste and aid in energy recovery through bioreactor technology.

An experimental study was carried out to treat the waste by anaerobic degradation using bioreactor. The experimental conditions maintained were:

***Flow-Through condition**- The leachate collected was not in contact with the pulp. The leachate flowed through the pulp and was collected in a separate leachate collection container. Two flow-through reactors were maintained. In one of the reactors, the leachate was re-circulated every three days and sludge was added along with the leachate every week for the first one month to promote microbial degradation. In the other leachate was removed every week and replaced with an equal amount of water.*

***Retention condition**- The leachate collected was retained within the reactor. The leachate flowed through the pulp and was collected at bottom of the reactor. Two retention reactors were maintained. In one of the reactors, the leachate was re-circulated every three days and sludge was added along with the leachate every week for the first one month to promote microbial degradation. In the other leachate was removed every week and replaced with an*

equal amount of water.

A number of tests were conducted to analyse the physical and chemical characteristics of leachate from all the reactors in order to study the biodegradation process. The parameters analysed included volume, pH, alkalinity, chlorides, BOD, COD, Total solids, Volatile solids, Ammonia-Nitrogen, Nitrate-Nitrogen, Organic carbon, Volatile fatty acids and sulphate and were analysed throughout the experimental period of 114 days.

The initial pH was 4.7 in flow-through reactors and 4.5 in control reactors indicating the acidic nature of waste. The recirculation reactors were found to attain the methanogenic phase faster than the control reactors indicating that recirculation expedites the biodegradation process. The temperature was in the range of 25-35 degree Celsius .The pH was in the desirable range and hence no external control was required.

The chemical oxygen demand and biochemical oxygen demand reduction was 74% and 82% in flow-through recirculation reactors respectively and 79% and 96% in flow-through control reactors. The average daily gas production per kg of waste was 64.28cc/kg/day for flow-through recirculation reactor and 50.13cc/kg/day for flow-through control reactor. The chemical oxygen demand and biochemical oxygen demand reduction was 81% and 95% in retention recirculation reactors respectively and 86% and 92% in retention control reactors. The average daily gas production per kg of waste was 112.47cc/kg/day for flow-through recirculation reactor and 96.62cc/kg/day for flow-through control reactor.

pH and volatile fatty acid peak values indicate that the recirculation reactors are attaining the methanogenisis phase at the earliest. Retention recirculation reactor was found to be most efficient in terms of BOD and COD reduction and also in the production of anaerobic gas due to the combined effect of retention, which aids in maintaining the optimum moisture content and re-circulation which enhances bio-degradation process due to the activities of the microbial population.

From the experiment it was found that solid waste generated by coffee processing can be treated efficiently by anaerobic degradation using bioreactor and also can be, simultaneously, used to harness bio energy in the form of methane produced in the anaerobic gas.