



# **ABATEMENT OF ODOUR FROM TOBACCO PROCESS EMISSIONS BY CONDENSATION, SCRUBBING AND BIOFILTRATION**

By

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## Abstract

A study was conducted to evaluate the removal efficiency of  $\text{NH}_3$  and Hydrogen Sulfide emitted from tobacco process emissions by biofiltration. The experiments were based on testing the removal efficiency of the contaminants on four types of packing material, namely: coconut fiber/tobacco compost, peat/wood chips, garden waste compost/wood chips and inert plastic media/garden waste compost. Results indicate that maximum removal efficiencies of ammonia and hydrogen sulfide (100% and 100% respectively) can be achieved for coconut fiber/tobacco compost mixture while similar removal efficiencies was obtained by peat/wood chips mixture. The maximum elimination capacities for ammonia for the respective packing materials were 5.59, 7.74, 4.58 and 1.98  $\text{gm}^3\text{h}^{-1}$ . Hydrogen sulfide maximum elimination capacities for the same packing materials were 6.99, 9.91, 6.04 and 2.96  $\text{gm}^3\text{h}^{-1}$ . The study was conducted as a preliminary evaluation for selecting the most suitable packing material relevant for application in an industrial scale biofilter for the treatment of the same waste gas stream.

An industrial biofilter of 23  $\text{m}^3$  in volume, packed with a coconut fiber filter medium inoculated with tobacco compost (20% by weight) was operated for a period of 45 days. The biofilter was supplied with a humidified gas stream from tobacco processing with main components being ammonia and hydrogen sulfide. The flow rate of the gas stream was varied from 1160  $\text{m}^3\text{h}^{-1}$  to 2100  $\text{m}^3\text{h}^{-1}$ . Results indicated that hydrogen sulfide and ammonia were effectively removed 100% and 95% under an empty bed retention time (EBRT) of 36s and 100% and 90% under an EBRT of 20s respectively. Maximum elimination capacities of 5.9  $\text{gm}^{-3}\text{h}^{-1}$  and 27.6  $\text{gm}^{-3}\text{h}^{-1}$  were reached for an inlet loading of 1'-8 $\text{gm}^{-3}\text{h}^{-1}$  and 3.8'' $\text{gm}^{-3}\text{h}^{-1}$  for ammonia and hydrogen sulfide respectively.

An industrial scale odour abatement system was designed and constructed, consisting of three units namely: condenser, scrubber and biofilter, the latter acting as the major unit of the system. The gas passes initially through a shell and tube heat exchanger



giving moderate pollutant removal (7% ammonia). The gas stream is then directed to a packed column scrubber where average removal of 85% ammonia and greater than 19% hydrogen sulfide was achieved. The two layer biofilter unit (24 m<sup>3</sup> in total volume) was packed only in a single layer (11.65 m<sup>3</sup> in volume) with a mixture of coconut fiber and tobacco compost (90/10 (w/w)) and was used to polish off remaining hydrogen sulfide completely while more than 95% of ammonia removal overall was achieved, resulting in a non odourous gas stream emitting to the atmosphere at ambient temperature. To our knowledge, this is the first waste gas treatment system employing the tri combination of condensation, scrubbing and biofiltration for the removal of odourous contaminants from tobacco waste gas.