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Assessment of a Wastewater Treatment Plant Performance in Accra (Ghana)

Having taken a course in Radiotracer Methods as part of the Master of Philosophy programme in Nuclear and Radiochemistry at the Graduate School of Nuclear and Allied Sciences, University of Ghana, my interest in the Industrial Application of Radioactive Tracer Technology was heightened. Therefore, for my MPhil thesis, I decided to investigate the performance of a wastewater treatment plant (WWTP) of an edible oil refinery using radioactive tracer technology. The Edible Oil Refinery used as the case study produces and supplies several popular brands of oil and rice to Ghana and neighbouring West African countries. The refining of crude vegetable oils generates large amounts of wastewater which are treated by the WWTP prior to discharge into water bodies within the catchment area of the edible oil refinery.

In the conduct of the investigation, a known activity of the radioactive tracer ^{99m}Tc in the form of Sodium Pertechnetate ($NaTcO_4^-$) was acquired from the National Radiotherapy, Oncology and Nuclear Medicine Centre (NRONMC) of the Korle-Bu Teaching Hospital in Ghana and deployed to the plant in a tungsten shield to prevent radiological exposure. The radioactive tracer was injected at the inlet of the WWTP and a data acquisition system comprising a laptop computer with Ceasar Software and NaI detectors was used for the detection of the injected tracer as well as radiation signal detection, data collection, treatment and visualization of the data. A total of four (4) collimated 2-inch Sodium Iodide (NaI) detectors were used in the investigations. The data acquired was processed to obtain the necessary hydrodynamic parameters which were used to identify anomalies in individual units of the plant and, hence, determine the plant's efficiency. The presence of dead zones and parallel flow were confirmed in the two (2) Cavitation Air Floatation (CAF) tanks of the WWTP. The investigation employing the radioactive tracer methodology was supervised by Dr. Hannah Asamoah Affum.

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Water quality analysis was also undertaken through determination of key physicochemical parameters of wastewater. The wastewater quality analysis was used as a secondary method to confirm the efficiency of the WWTP. The degree of reduction of pollutant levels in the wastewater after treatment gives an idea of the Pollutant Removal Efficiency of the WWTP. Evaluation of performance (pollutant removal efficiency) of the investigated WWTP was undertaken through assessment of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and, Oil and Grease (O&G) of influent and effluent. The influent COD/BOD_5 ratio (Biodegradability Index) was also assessed. The wastewater quality analysis was performed under the supervision of Dr. Dennis Adotey. The removal efficiencies obtained were appreciably good; and comparable to efficiencies reported in similar studies by other investigators. Additionally, levels of physicochemical parameters in the treated wastewater (effluent) compared favourably with recommended limits by international organizations.

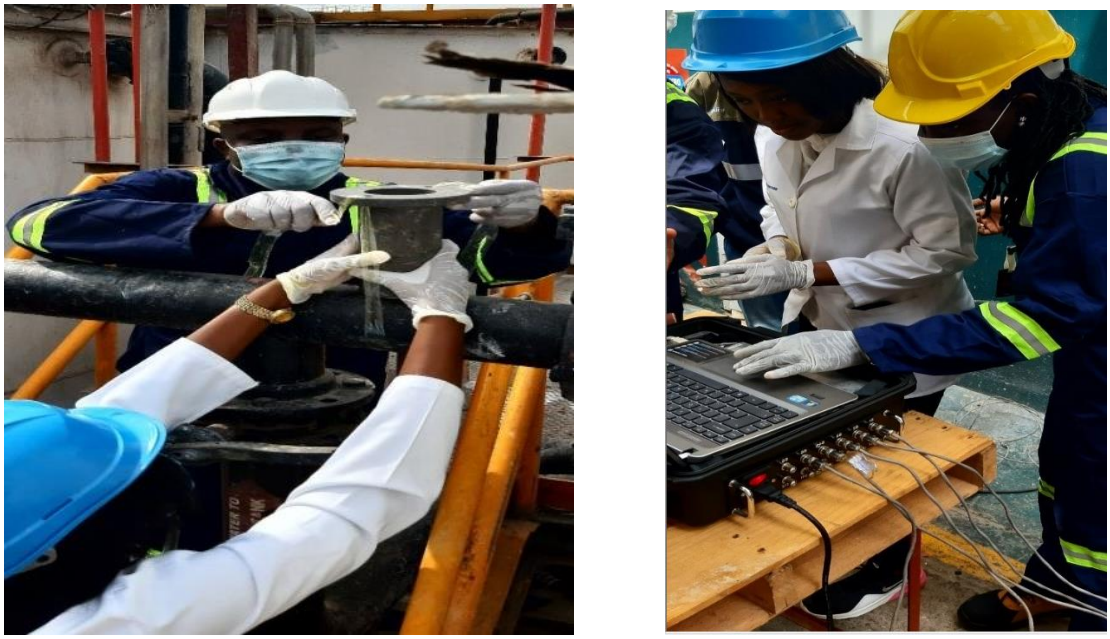

Fig. 1. Mounting of detector collimators (left) and background radiation counting initiation (right)

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Fig. 2: Research Team engaged in effluent quality assessment (left) and viewing detector response display of data acquisition system (right)

The authors would like to acknowledge the refinery, its technical and administrative staff and NRONMC for the massive collaboration and immense support rendered to the team during the investigation.

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photos: Eric Borketey Bortei (Figures 1 and 2 right)
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