

Bioremediation Techniques for Oil-Sludge Treatment at the Arun Field

Mohamad Yani¹, Agung Dhamar Syakti^{1,2}, Syahrul Radhi³, Novita Khanim³
and BPMIGAS Reps⁴

¹ Center for Coastal and Marine Resources Studies of Bogor Agricultural University

² University of Jenderal Soedirman, ³ ExxonMobil Oil Indonesia Inc.,

⁴ Executive Agency for Upstream Oil and Gas Business Activities

Abstract

Slurry sludge that contains hydrocarbons and heavy metals compounds were generated from drilling activities and production processes in the Arun Field in North Aceh. The sludge was categorized as a hazardous and toxic waste, and it required special handling and treatment. As a part of the overall waste management program, the sludge was treated by applying bioremediation technology to reduce the concentration of environmental pollutants to levels considered acceptable by the Indonesian Regulatory agencies. The pre-treatment sampling result showed that the Total Petroleum Hydrocarbon (TPH) concentration of the sludge was in the range of 2-4% and heavy metal compounds such as lead, zinc and mercury were above the government limits.

Three biological methods applied to treat the waste such as water lagoon, slurry and biopile. Cultured indigenous microbial consortia were introduced to remove and transform targeted pollutants. The water lagoon approach reduced oil & grease, pH, COD, H₂S, NH₃, and total Phenol to below the produced water threshold. Meanwhile slurry and biopile techniques showed a reduction of TPH, PTEX and heavy metal concentrations. Combination of those methods resulted in an effective and efficient way to reduce petroleum waste and petroleum contaminated soil pollutants to unharmed to human health and environment. An acute toxicity test (LD50) to *Mus Musculus* was demonstrated that showed a significantly improved sludge quality.

The biotreated soil was spreading *in-situ* and applying vegetation such as sun flower, gume cover crops, *Jatropha*, and wild plants that grows healthy and fruit well. Series monitoring programs were conducted on quarterly basis, after one year, the average of PH of bioremediated soil was 2150 ppm versus 10,000 ppm regulation, the water quality of two monitoring wells were also below regulation limit.

Keywords : biodegradation, toxicity, *in situ*, microbial consortia

INTRODUCTION

Oil and Gas Industries in Indonesia have significant contribution as a leading sector to the country growth. These industries have multiplier effect for national economic such as creating job opportunity and generating new economic activities that strengthen local community around concession area. However, Oil and gas production processes done by