# Physical and chemical characterization of the slimes in selected Malaysian tin slurry ponds for reclamation purposes

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As part of the national research project on the Malaysian Tin Slurry Pond Reclamation, which was financed largely by the International Development Research Centre, Canada (IDRC), two ponds were selected for characterization. A large pond within the Mines Research Station, Malim Nawar, Perak, represents a pond left over from the dredging operation while a smaller pond located at Pengkalan, Perak, was a former slime pond of a gravel pump-palong operation. Both ponds are underlain by limestone/marble bedrock though the deeper bedrock of the Malim Nawar pond was never exposed during the dredging operation.

Manual sampling of the soft slime layer from both ponds was accomplished using a triple cluck-valve sampler adapted onto light weight alloy drilling rods. Two flat bottom boats rigged together provided a catamaran style platform for the sampling. Sampling was carried out on grids of 80 m by 40 m and 40 m by 40 m, and slime samples were collected for every 1 m vertical interval. The sampling points were fixed using a EDM Tellerumeter based at strategic positions by the pond edge.

The slime samples collected were analysed in the laboratories of University of Malaya, Universiti Teknologi Malaysia, Geological Survey Laboratories and the Mines Research Institute, for their chemical, physical, mineralogical and engineering properties. The pond water and the slime pore fluid were also tested for their anion and cation contents.

Based on the engineering properties, soft slime from the two ponds are not suitable as foundation materials unless treated. Mineralogically, the major component of the slime is kaolinite (60% to 75%), with significant amounts of illite (from 8% to 10%). In addition, the Malim Nawar pond contained amorphous clay while the Pengkalan pond contained montmorillonite. The average solid concentration of the slime is around 52% while the specific gravity is 2.6.

The specific surface area of the solids in the slime is higher in the Malim Nawar pond (35.5 m/g) compared to the Pengkalan pond (24.1 m/g). The cation and anion contents of the pond water and pore fluid are within the normal range though the calcium content in the pond water is relatively higher; 17 ppm for Malim Nawar and 37 ppm for Pengkalan. The calcium content in the pore fluid of the slime is even higher; 50 ppm for Malim Nawar and 239 ppm for Pengkalan. Concentrations of exchangeable cations in the slime are



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low with the exception of calcium. Organic content of the slime, ranging from 1.5% to 2.0% and the bacteria content of $1.3 \times 10^3$ to $2.9 \times 10^4$ colonies/g, must be regarded as low and will not affect slime properties to any marked extent.

An increase with depth in the particle size and specific gravity of the slime is observed in the Malim Nawar pond and is less clear or erratic in the Pengkalan pond. The solid concentration of the slime in the Malim Nawar pond shows a broader range of increase with depth compared to that of the Pengkalan pond.

Studies on the electrophoretic mobilities indicate that clay particles of the slime from the Malim Nawar pond show a higher negative surface charge compared to that of the Pengkalan pond, which apparently was neutralized by the calcium ions which were present in much higher concentrations in the water.

Based on the differences of several physical and chemical parameters, it is concluded that the slime from the Malim Nawar pond (dredging) had settled at a slow rate after it had been discharged into the pond. In the case of the Pengkalan pond, the slime, after having separated from the sand by the spray-stacked method, had settled down fast and en masse. It is also suggested that the high content of the calcium ions in the mine water which came into direct contact with the limestone bedrock during the mining (gravel pump-palong) had probably helped to neutralize the surface charges of the montmorillonite (in the Pengkalan slime) to make it settle faster than under normal circumstances.

The next stage of the research is aimed at identifying a suitable chemical for dewatering the slime, which will then allow it to be effectively surcharged and drained to achieve platform or foundation grade material.