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Removal of Carbofuran from Drinking Water Using Natural Rutile

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Abstract

Water bodies contaminated with pesticides is a major constrain faced by every agriculture based country. Providing safe potable drinking water to public has proved to be a challenge in such situations. Rutile is found in enormous concentrations in the Pulmoddai beach sand deposit, and is exported as raw material since 1968, without utilising the deposit for any other purpose.

There were number of reports published regarding the photocatalytic effect of rutile and use of pure titanium dioxide to remove pesticides globally, but according to the available literature, no studies on the potential effect of natural rutile sand in Sri Lanka has been carried out for water purification facility. Therefore, this is the first record on profitable utilisation of the rutile mineral deposit for development of water treatment technology in Sri Lanka. The natural rutile sand for the experiment was supplied from the mineral deposit of Pulmoddai, Eastern Province.

The photocatalytic activity of natural rutile sand was induced by providing ultra violet (UV) illumination. In vitro laboratory experiments were carried out to assess the photocatalytic ability of natural rutile sand on carbofuran. The results revealed the potential photocatalytic degradation of carbofuran by natural rutile sand. The carbofuran removal efficiency of natural rutile was compared with pure titanium dioxide (TiO₂). The results showed that removal rates of carbofuran by natural rutile sand with UV illumination was 72%, whereas pure granular/powder TiO₂ showed 74% and 76% of degradation of carbofuran respectively. When carbofuran was exposed to only UV light treatment, 33% of carbofuran reduction was effected.

Based on the results obtained, a filter model was designed using natural rutile sand and evaluated the potential use of natural rutile sand to remove carbofuran. The filter model showed that there were 46%, 50%, 61%, 65% and 71% removal of carbofuran at 60, 120, 180, 240 and 300 minutes respectively, for a water circulation rate of 500l /h.

The study showed that there is an enormous potential of utilising natural rutile sand to remove hazardous pesticides from water and the result will help to improve a water filter in future as well.

Keywords: Carbofuran, Photocatalysis, Rutile, Water purification