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DEVELOPMENT OF FLOCCULATING PADDLES IN MOBILE WATER TREATMENT PLANTS

By



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This thesis was submitted to the Department of Mechanical Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Engineering in Manufacturing Systems Engineering
University of Moratuwa



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DECLARATION

This Dissertation paper contains no material which has been accepted for the award of any other degree or diploma in any University or equivalent institution in Sri Lanka or abroad, and that to the best of my knowledge and belief, contains no material previously published or written by any other person, except where due reference is made in the text of this Dissertation.

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ABSTRACT

Water is precious for every living being. It covers almost 75% of the earth's surface. Only about 3% of the water on earth exists as fresh-water and most of it is not easily available to men.

Freshwater sources are polluted by activities of men, animals and by natural disasters. Water pollution is dominated by industrial and domestic wastes through channels and drains. Treating this water to meet standards of drinking quality is a huge task and a costly process.

Many countries face the problem of providing safer drinking water rapidly when faced with disaster situations like thousands of refugees as a result of civil disturbances, or natural disasters such as tsunami-related events, earthquakes, landslides, droughts or in an event of floods. The main issue is to construct water treatment plants which are heavy concrete structures in a shorter period of time in a limited land space.



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The R & D section of the National Water Supply and Drainage Board (N.W.S.& D.B) has designed and fabricated a moveable water treatment plant using locally available materials and expertise within an affordable capital cost . Three of these mobile type water treatment plants have being installed in Pugoda, Mahiyangana and Allauwwa.

This type of water treatment plants can dismantle into separate sections. They are fabricated steel tanks as middle stages of water treatment plant array. These sections can be transported to another place, re-assembled and re-located.

The Pugoda plant has a mechanical flash mixer and three speed mechanical tapered flocculators. Flocculating is done by four paddle rotors rotated by geared motors in three speeds in three adjacent tanks. These paddle wheels (rotors) are mounted on a horizontal axis inside the tank. The two ends of axel are sealed and supported by two end bearings housed

beside the tank steel wall. This arrangement of the paddle wheels gives many operational and maintenance difficulties when dismantling the bearings and water seals.

Very frequently chemically mixed water leaks through the water seals and bearings. This leads to reduce productivity by reducing bearing life, equipment safety and increasing down time, power requirement and operational cost. It needs a substantial quantity of water to remove the sludge in the bottom bed by washing them out.

The objective of this special study is to study the ways and means of improving the present installation arrangements of flocculator paddle wheels and to propose an alternative arrangement eliminating above operational difficulties. Objective is to find an efficient alternative mechanical flocculator system to be used in package-type water treatment plants.

This report discusses about conventional water treatment arrangement, a brief study of floc forming phenomena, specification of the mobile water treatment plant, flocculator types and other arrangement types of mechanical flocculators used elsewhere in the world. The report includes theoretical aspects of power requirement for rotating paddles.

The study also proposes a vertical arrangement of flocculating. This is by fabricating frame and a plate to mount the gear box and motor. This frame is fitted on to the top frame of the tank. The axes of the paddle wheel is supported by two bearings, one is top of the channel section and the other is submerged in the water. The housing shall be fixed to fabricated plate to bottom of tank. The bearing shall be water resistant type and fully water tight by seals.

The advantages expected from this arrangement are to prevent water leaks, long life of seals, bearings and couplings and to reduce operational and maintenance difficulties thus reducing operational costs and reducing the amount of sludge washing water.

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