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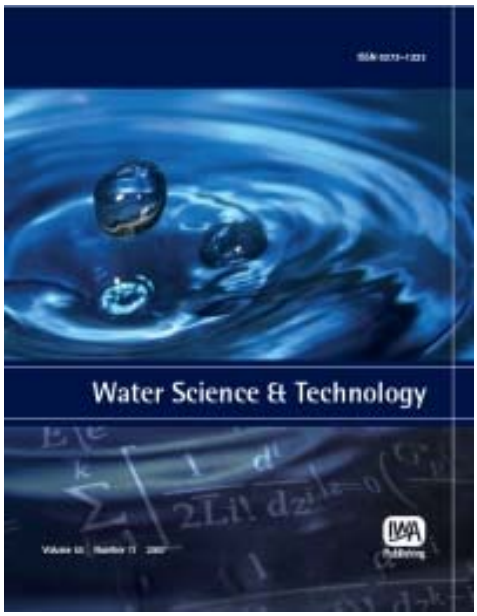

Oil droplets and solid particles removal using circular separator with inclined coalescence mediums: comparison between co-current and counter-current flow

L. H. Ngu, P. L. Law, K. K. Wong and A. A. R. Yusof

ABSTRACT

This research investigated the effects of co- and counter-current flow patterns on oil-water-solid separation efficiencies of a circular separator with inclined coalescence mediums. Oil-water-solid separations were tested at different influent concentrations and flowrates. Removal efficiencies increased as influent flowrate decreased, and their correlationship can be represented by power equations. These equations were used to predict the required flowrate, Q_{ss50}, for a given influent suspended solids concentration C_{iss} to achieve the desired effluent suspended solids concentration, C_{ess} of 50 mg/L, to meet environmental discharge requirements. The circular separator with counter-current flow was found to attend removal efficiencies relatively higher as compared to the co-current flow. As compared with co-current flow, counter-current flow Q_{ss50} was approximately 1.65 times higher than co-current flow. It also recorded 13.16% higher oil removal at influent oil concentration, C_{io} of 100 mg/L, and approximately 5.89% higher TSS removal at all influent flowrates. Counter-current flow's better removal performances were due to its higher coalescing area and constant interval between coalescence plate layers.

Key words | circular phase separator, co-current flow, counter-current flow, inclined coalescence mediums, oil-water-solid separation

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INTRODUCTION

Oil-liquid-solid separators with coalescing plates are enhanced gravity separators which are generally rectangular separators (Metcalf & Eddy 2004). Rectangular separator has a constant horizontal velocity, v_h, throughout. Rectangular enhanced gravity separators generally adopted co-current flow pattern for removal of suspended solids whilst oil gravity separators utilised counter-current flow (Reynolds 1982). There are many publications dealing with the practical experience of installing inclined coalescence plate in existing rectangular gravity separator to improve separation efficiencies, such as Saleh & Hamoda (1999), Burns & Mohr (2000) and Gutierrez *et al.* (2000). Rommel *et al.* (1992) studied droplet coalescence process and developed a theoretical design process of plate separators.

In a circular separator, horizontal velocity, v_h, continually decreases as surface area increases (Deininger *et al.* 1996). Circular enhanced gravity separator with coalescing plates had not been extensively developed and used for treating oil, grease and suspended solids (Davis & Cornwell 1991). The scope of the present paper is concerned with the separation of oil droplets and solid particles in circular separator with different flow direction. The circular separator used has an upflow centre-feed perforated-pipe distributor (Ngu *et al.* 2004) to direct flow to the inclined coalescence mediums to provide a co-current and counter-current flow depending on the arrangement of the coalescence mediums.

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