

Process reagents for the enhanced removal of solids and water from oil sand froth

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Abstract

The theory of inclined plate separator (IPS) operation is studied from the standpoint of the possibilities for the use of reagents to promote improved dewatering and demineralisation of oil sand froth. The potential for the use of CFD methods to determine the efficacy of these chemicals is also reviewed. For most purposes chemical additions are added in experimental programs as a means of determining the asymptotic limits for product quality figures of merit achievable without the use of chemicals. This is because volumetric flows in oil sand processing are so great that the addition of chemicals is not encouraged due to the enormous cost factor that becomes inevitable in most cases. Therefore, the focus of this paper is on the overall strategy of avoidance of the use of artificial chemical process aids, in other words reagents, but depending more upon natural process aids that occur in the oil sand or in the diluents and solvents used to extract hydrocarbon.

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1. Introduction

The inclined plate settler has been used mainly as a gravity settler in water treatment and in mineral processing applications where space for a conventional gravity settler is limited. By stacking plates in a pack a smaller footprint is obtained for a given area of effective clarification. Also the distance of settling is reduced by orders of magnitude from that of the conventional thickener. In principal, the IPS device sees material fed into a plate pack from the bottom as depicted in the simplified diagram shown as Fig. 1. In this mode the flat plates (lamellae) provide an overflow path for a portion of the IPS feed consisting of a suspension of particles in a continuous homogeneous carrier. Within the plate pack, particles will settle due to gravity if they have a density

differential with respect to the effective carrier or vehicle. Since most applications involve a particle size distribution ranging from very fine to reasonably coarse ($+74\ \mu\text{m}$) particulate, the notion of pure settling requires modification to allow for hindrance of coarser particles by finer particles. This complication by itself is reasonably tractable and has a strong theoretical basis in mineral processing. However, there are other issues, which relate to the complexities of flow between the small plate gaps in the inclined geometry.

Reagents have been added to IPS feed in order to provide an increased driving force for water coalescence and settling. At the same time reagents have been added to increase the settling of fine solids, most of which are substantially water-wet. In addition, the choice of naphtha or solvent has been tailored to enhance these two processes. In order to be able to improve performance it is becoming clear that fundamental theory needs to be sufficiently developed to be able to determine the

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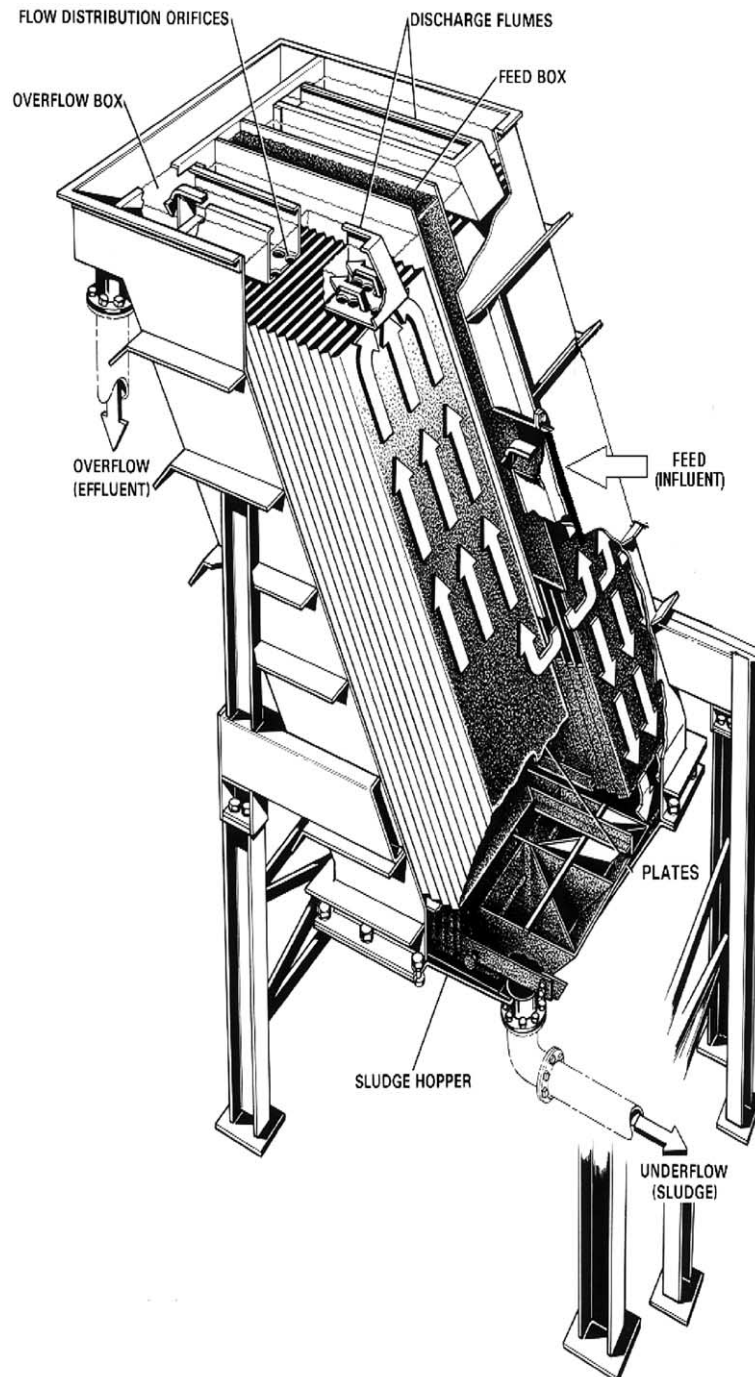


Fig. 1. Inclined plate settler—courtesy Parkson Corporation.

nature of stream flows within the IPS plate packs. Solving these problems will require the establishment of CFD (computational fluid dynamics) models. This paper seeks to develop such a formalism, but does not complete the solution of the related boundary value problems. The paper does address the question of intractability, which is explained in terms of the several wall-effects that are associated with hydrocarbon slurries. The issues raised in this connection are applicable

also to hydrocarbon cyclones, the companion unit operations in a froth treatment processes. This froth treatment process is described in a pending patent (Garner et al., 2004). Fig. 1 shows the internals of an IPS unit.

The **Boycott effect** (1920) is a name coined to describe the first-order enhancement of particle settling due to the inclination of the plate pack. At first this effect was attributed to Brownian motion, but as Boycott showed it was rather a matter of the geometrical impact of the

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