A model for batch settling curve

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Abstract

A model is developed for describing sludge blanket interface settling in a batch reactor. The sludge settling curve is considered as one entity, not as a congiomerate of several separate parts, and thus described in one model. The model interprets sludge settling as a time-dependent phenomenon and it describes the settling process from the beginning to the end. Since the whole settling curve is modelled, sludge settleability is accurately assessed. Two parameters of the model can be easily estimated with a non-linear estimation method. The derivative of the model can be used for computing sludge blanket interface settling velocity. The agreement between the observed and the computed activated sludge settling curves shows that the proposed approach is justified.

Nomenclature

a (kg-m-^{2}-h~1) and C (mh-^{1})	are parameters describing sludge settling
a(X,h_0)	a function dependent on activated sludge concentration and the initial sludge blanket interface level (h^1)
P	a parameter for modelling small concentrations (kg^2·m^{-6})
h_{long}	the sludge blanket interface level (m) after a long settling period
	the sludge blanket interface level (m) at time t
h_0	the initial sludge blanket interface level (m)
SVI	sludge volume index (ml-g-^{1})
t	time (h)
X	activated sludge concentration (kg-m-1)
ZSV	zone settling velocity (m-h-^{1})-

Introduction

Successful waste-water treatment requires that particles which are formed during biological and chemical treatment should be removed from the water. A predominant unit process for solids separation is gravity sedimentation. Increased influent flow during sustained rainy periods, as well as the tendency for chemical-free waste-water treatment, cause additional requirements for settling tanks operation.

Operation of final settlers can be optimised only when sludge settleability is known. In addition, detection of sludge settleability problems in daily monitoring allows operators of waste-water treatment plants to take measures to avoid or reduce operational problems. The optimisation of clarifier operation and the significance of observation are dependent on the accuracy of the method describing sludge settleability.

Settling properties of activated sludge are generally described by SVI. Despite its widespread use, SVI has been strongly criticised because of its shortcomings: two differently settling sludges can have identical SVIs (Fig. I), it depends largely on initial sludge concentration (Fig. 2), and has limitations in comparison to settleability of sludges from different plants. Due to these constraints, several alternative methods for settleability

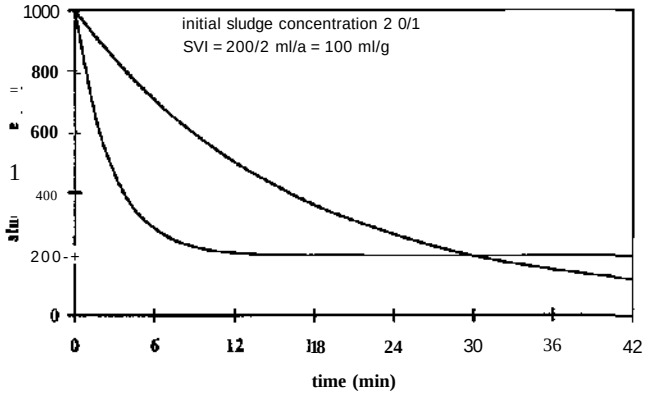

Figure 1
Two sludges with different settling characteristics have identical SVI values

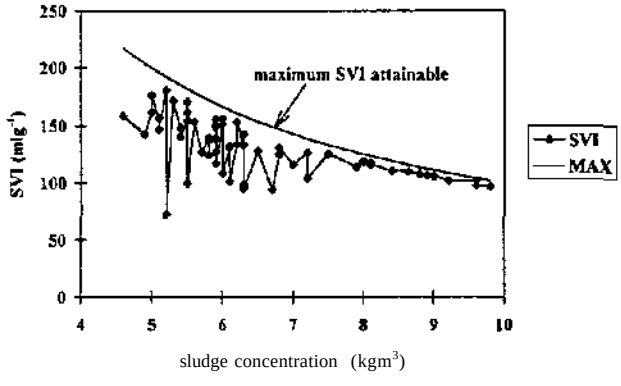

Figure 2
The effect of initial sludge concentration to SVI (Kiuru et al, 1996)

description have been suggested and investigated (e.g. Dick and Vesilind, 1969; Fitch and Kos, I976: Wilson, 1983; Hultman .et al., 1991; Catunda and Van Haandel, 1992).

ZSV of activated sludge is one of the experimental methods used for describing sludge settling, instead of SVI. ZSV is well known but not as much used in daily monitoring of treatment plants as the traditional SVI. Measuring for ZSV is laborious and

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