PSS Dynamics Model page

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Introduction

The current theory of plate settlers predicts the failure for a specific sedimentation tank and plate settler spacing based on a failure mechanism called floc roll-up. The floc roll-up theory states that a floc hitting the bottom plate will experience both a fluid velocity at its edge and a settling velocity. If the fluid velocity is higher than the settling velocity, then the floc will roll up the plate and will exit the plant without being captured.

This theory is based on the following assumptions:

- The velocity profile at the edge of the particle is linearized.
- Flocs are following straight lines.
- Flocs are spheres.
- There is no floc breakup or collision.
- The presence of flocs do not affect the velocity profile.
- The entrance region of a plate settler (where the velocity profile is not fully-developed) is ignored.

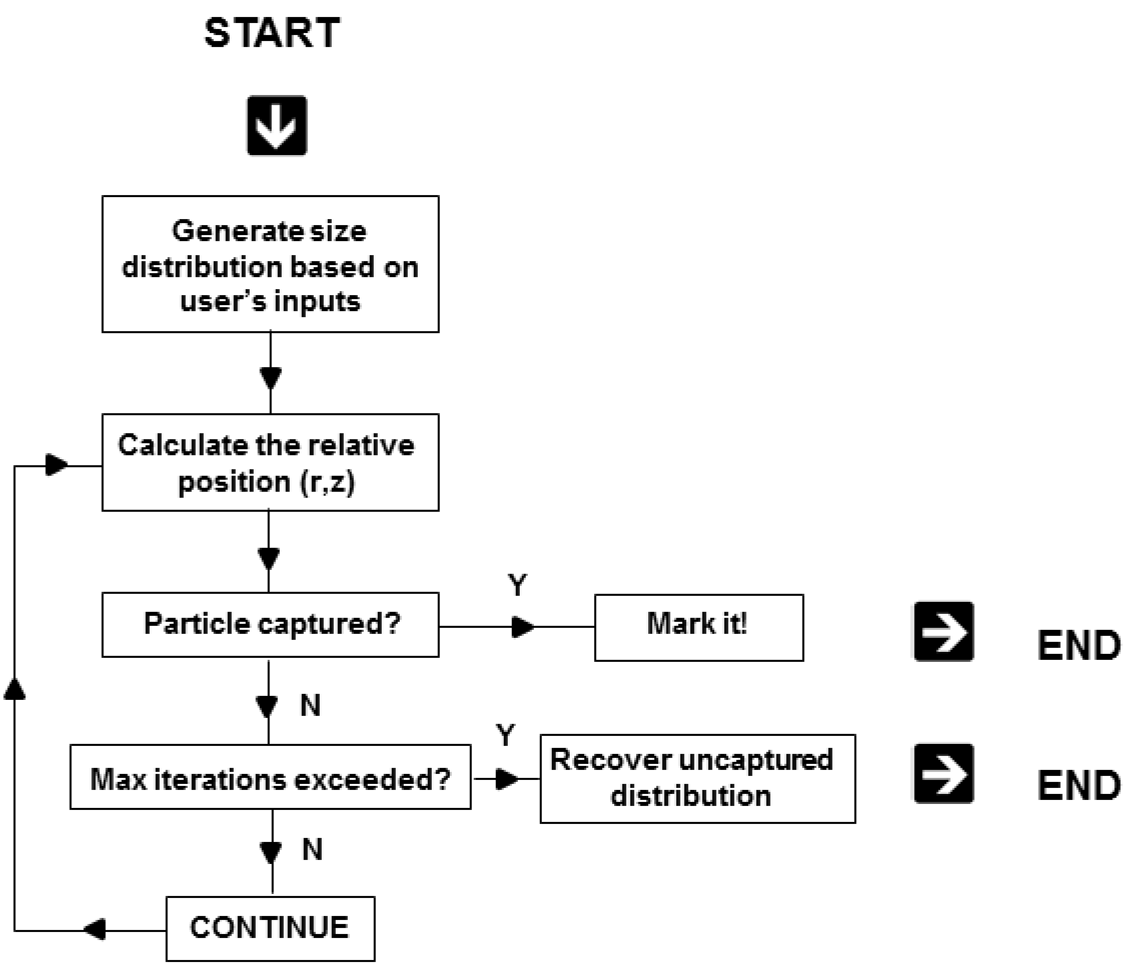
The current theory predicts failure by the mean of a dimensionless $\prod$ ratio which is explained on this page: Appendix pdf - Equations etc. . When this ratio is less than one, then the effluent turbidity should be above 0.25 NTU. This means that the spacing for a given flow rate is going to be above the maximum allowed turbidity.

Our first experimental results showed that this ratio is able to predict effluent turbidity that will be above 0.25 NTU but it is unable to predict the magnitude of failure.

Therefore, the PSS team concluded that a numerical simulation taking more phenomenon into account is needed in order to be able to better understand the failure mechanisms and be able to assess the effluent turbidity.

How does the code work?

The code works on a Velocity-Verlet algorithm which computes all particles paths based on their experienced local velocities. The code takes particles sizes, the tube (or plate) geometry, and the up flow velocity as an input. The figure below summarizes the steps taken by the algorithm:



The output of the program is the number of particles that were not captured and their respective paths.

Further Developments

The team plans to adjust some of the parameters in order to be able to compare (at least roughly) the results and predictions of the numerical model with the experiments.

Further steps include implementing more interactions than floc roll up (e.g. floc break-up, floc recombination and how flocs influence the local velocity profile. Hence, the plate settler performance).

Attachments

trajectory9.m ||The main file. Contains the input parameters as well as the velocity-Verlet algorithm

Vfluid.m || Function that computes the velocity profile as a function of the distance inside a tube or plate settler

Re.m || Function that computes the Reynolds number (required for modeling the entrance region)