Analysis of a Sand Separator

Separation of water and sand is analyzed with Particle Tracking Method using SC/Tetra

Particle Tracking Method

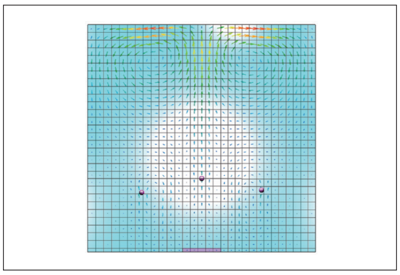

Figure 1: Two way coupling

In Particle Tracking Method, fluid is analyzed as a continuous phase by using grid-patterned elements as shown in Figure 1 (Euler method), while particles are tracked individually as dispersed phase (Lagrange method). Fluid and particles are analyzed interactively.

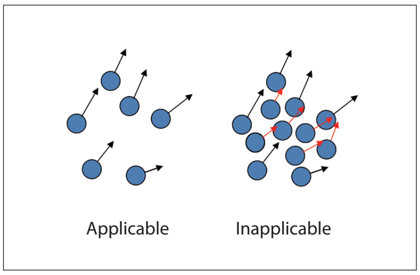

Figure 2: Application of the particle tracking method

In Particle Tracking Method, particles are considered as point masses; this means that the method should not be applied for an analysis where contact or collision of particles is dominant as shown in Figure 2.

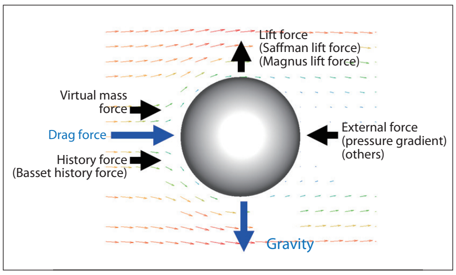

Figure 3: Forces acting on a particle in fluid

When density of particle is greater than that of fluid, the drag force and gravity are the main forces acting on the particle. Because the drag force is calculated assuming that the geometry of particle is a sphere, a care should be taken for sand or dust, which is not usually a sphere, or for droplet, which changes shape.

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Analysis model

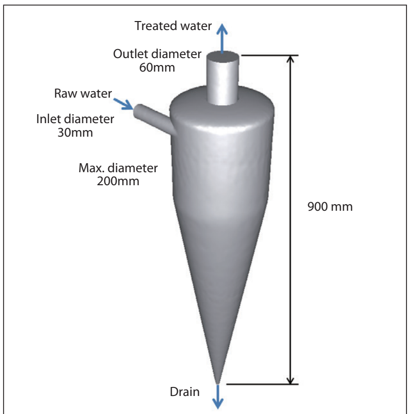

Figure 4: Sand separator

Analysis results

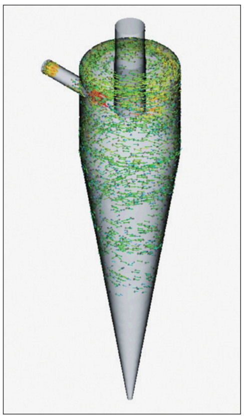

Figure 5: Particle behavior

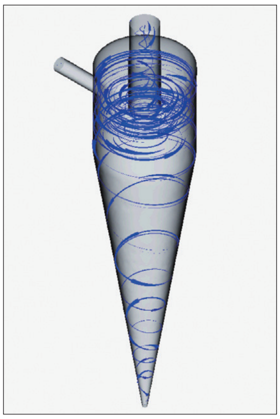

Figure 6: Streamlines

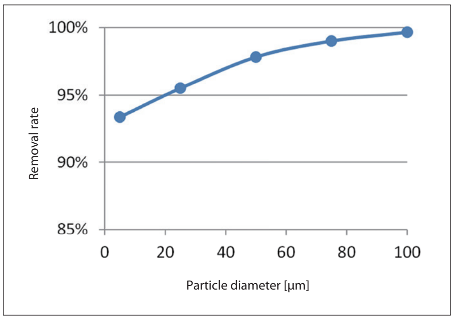

Figure 7: Variation of the sand removal rate depending on the particle diameter

Sand separator

Separates sand from water using centrifugal force. Ratio of density of sand and water is approximately 2.5, which is much smaller than that of sand and air. Separating sand from water is difficult.

The inflow rate of raw water is fixed at 2.8 [m^3/h]. Approximately 3% of the water flows out the drain. Next, 100 sand particles with a fixed diameter and a density of 2,500 kg/m^3 are injected into the inlet with the raw water every 0.1 seconds. The separation state is analyzed using the particle tracking method for 30 seconds. The sand removal rate is calculated by dividing the number of sand particles going out the drain by the total number of particles going out the drain plus the number in the treated water.

Notes

- Figure 5 shows the analysis result of the behavior of sand particles with a diameter of 100 [μm]. The behavior of the particles is shown using velocity vectors until 7 seconds after the analysis starts. The particles flow in with the raw water, move downward along the separator wall, and flow out with the drain.
- In Figure 6, streamlines of the water are expressed with arrows. The swirl flow occurring in the separator is clearly simulated.
- Figure 7 shows the variation of the sand removal rate depending on the particle diameter, for 5, 25, 50, 75, and 100 μm diameters. The smaller the particle diameter is, the lower the removal rate becomes.