Environmental Technology in Mining

Chapter I. Mine Gases

2. Mass balance

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Mass balance

A mass balance or material balance can be viewed as an accounting procedure

Input + Generation = Output + Accumulation

Input = Input (mass rate) of materials
Generation = Implies chemical reactions
Output = Outflow (mass rate) of materials
Accumulation = Mass rate of accumulation

No chemical reactions → Input = Output + Accumulation

Mass balance

Application of conservation of mass to the analysis of physical systems

When input = output there is no accumulation: STEADY STATE

STEADY STATE implies that time is not a factor.
The concentration or amount of a substance in the control volume does not change with time.

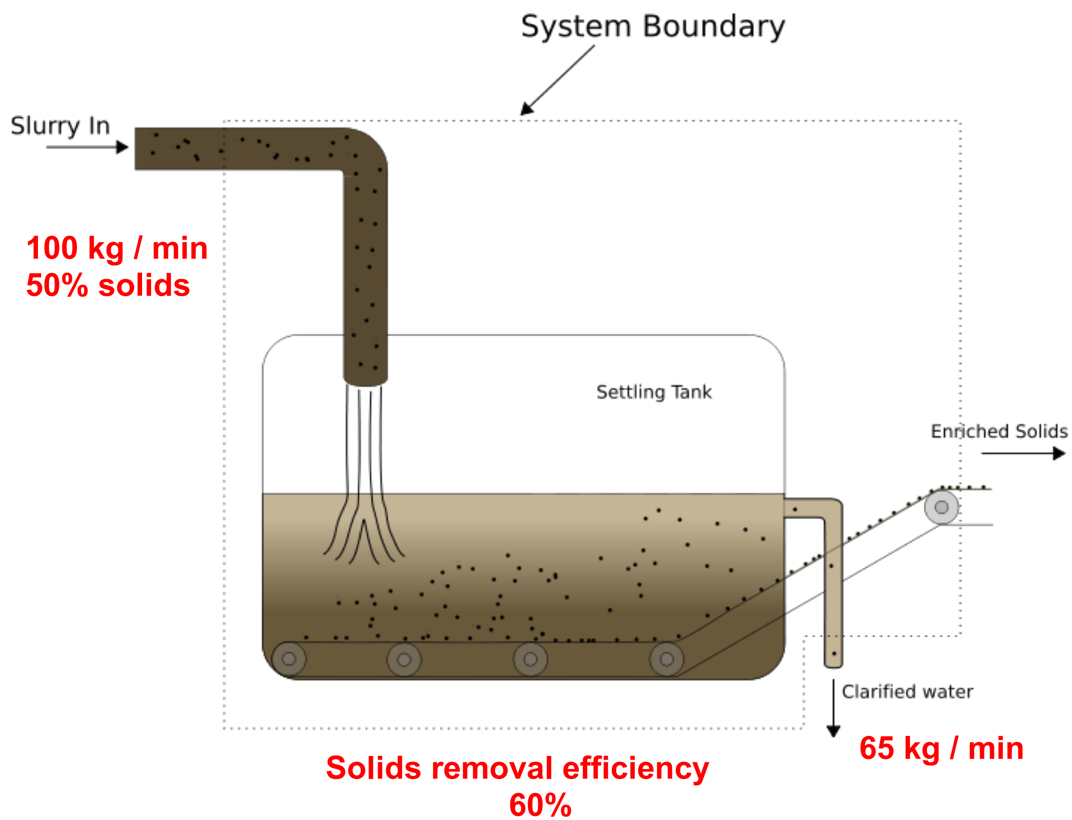
Mass balance example (source Wikipedia)

Consider the situation in which a slurry is flowing into a settling tank to remove the solids in the tank. Solids are collected at the bottom by means of a conveyor belt partially submerged in the tank, and water exits via an overflow outlet.

In this example, there are two substances: solids and water. The water overflow outlet carries an increased concentration of water relative to solids, as compared to the slurry inlet, and the exit of the conveyor belt carries an increased concentration of solids relative to water.

Assumptions

Steady state
Non-reactive system (No chemical transformations)

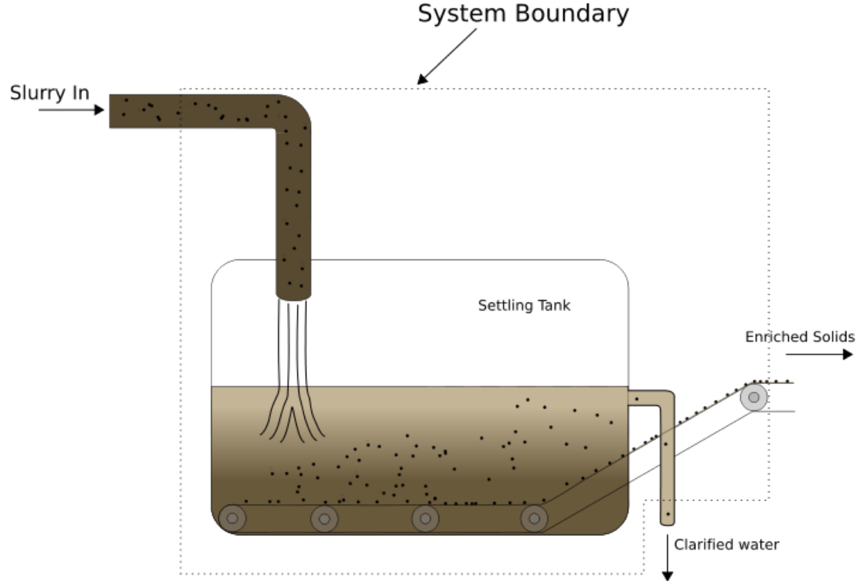


How to close the balance?

Mass balance example (source Wikipedia)

INPUT

F_i = 100 kg/min
F_{i-H2O} = 50 kg/min
$F_{i-Solids}$ = 50 kg/min



OUTPUT

F_{ES} = 35 kg / min
Fsolids = 50-20 = 30 kg/min
F_{H2O}= 5 kg/min
Csolids = 30/35 = 85.7%

F_{CW} = 65 kg / min
Fsolids = 20 kg/min (60% efficiency)
F_{H2O}= 45 kg/min
Csolids = 20/65 = 30.7%.