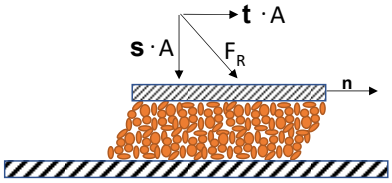
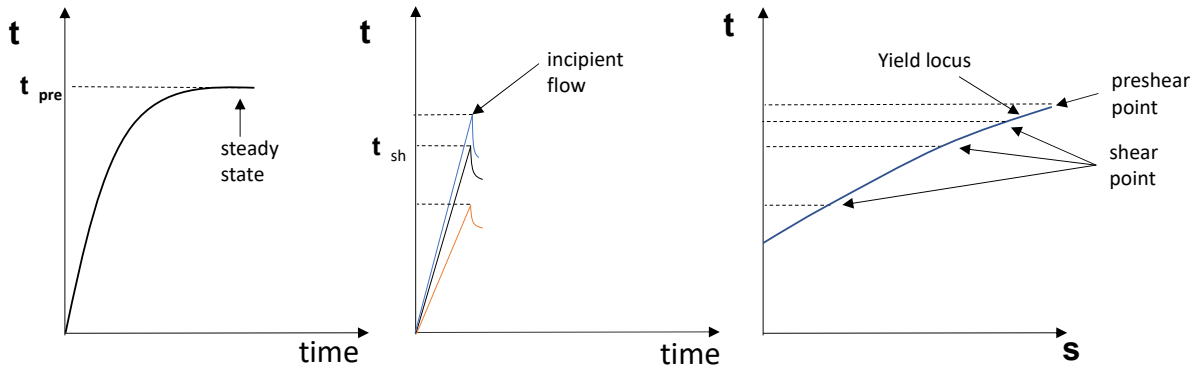
Basic knowledge: physical properties of bulk solids III; Flow properties (shear cell)

The basic definition of the flowability and the influencing factors was covered in my previous blog. I'd now like to get more detailed into the determination of the flow properties by shear testing.



The goal of shear tests is to measure the yield limit of a consolidated bulk solid. The yield limit for bulk solids is called the yield locus. As shown in the pictures below the bulk solids are loaded vertically by a defined stress "**s"** and with a shear stress "**t"** that gives a resulting force F_R. The shear stress is applied with constant velocity until steady state is achieved, which means the shear stress remains constant and doesn't further increase. This step of the test is called "preshear."

In the next step called "shear," the vertical preload "**s"** is reduced and a shear deformation is applied. The needed shear stress to failure is recorded. As the sample is not fully consolidated as it is in the preshear test, the shear stress is reduced once the bulk solids reaches incipient flow.

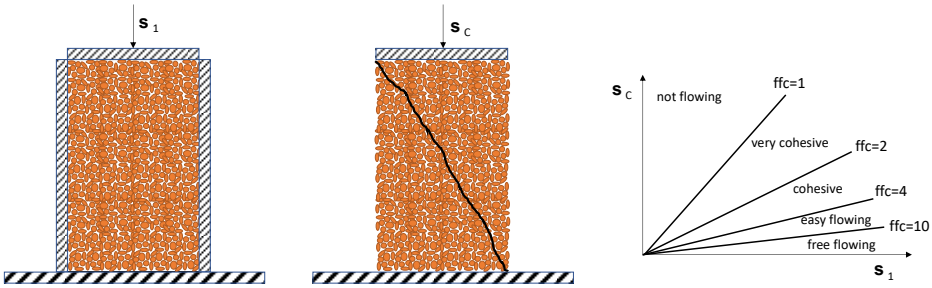


The yield locus is a summary of all tests performed. It provides information of bulk solids respective flow

- **Very cohesive:** The solids severely consolidate and do not flow by gravity out of a silo or hopper; the solids need substantial promoting devices or cannot be discharged.
- **"Sticky/not flowing:** Solids are basically sticking together and do not flow

Following Jenike, the flowability can be described as shown in the figure below:

s_1 is the consolidations stress and s_c is the unconfined yield strength. The ratio $ff_c=s_1/s_c$ is an indication on the flowability



In the next part, I will talk about checking flowability through shear testing.
As always, please do not hesitate to message me with questions/comments.

Gerald Marinitsch, has broad and comprehensive background in management, mechanical and process engineering and since 2014 is working with a team of experts at Solex on heat exchangers for bulk solids.

'After several years of working with bulk solids heat exchangers, I realized that bulk solids knowledge is not widely spread throughout the engineering society. Consequently, I decided to summarize some basic knowledge in a series of articles '

+43/650/420 23 66 – Gerald.Marinitsch@solexthermal.com