

Influence des faciès particulaires sur les aptitudes à la filtration et au drainage

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Influence des faciès particulaires sur les aptitudes à la filtration et au drainage

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Abstract

Filtration properties as cake resistance and compressibility are used to design the filtration device needed for each liquid-solid separation. These properties principally depend on particle properties. Particle diameter, particle size distribution, shape factor and shape factor distribution have a major influence on cake properties. A correlation between all particle properties and filtration properties is presented. Filtration properties are predicted by a MATLAB simulation and compared to the experimental results. The paper aims at pre-evaluating cake resistance and deliquoring abilities by knowing only the particle size distribution, giving the industrial a key to choose and design his liquid-solid separation equipment.

Keywords: Filter cartridge, filterability, cake, cake formation, filter test.

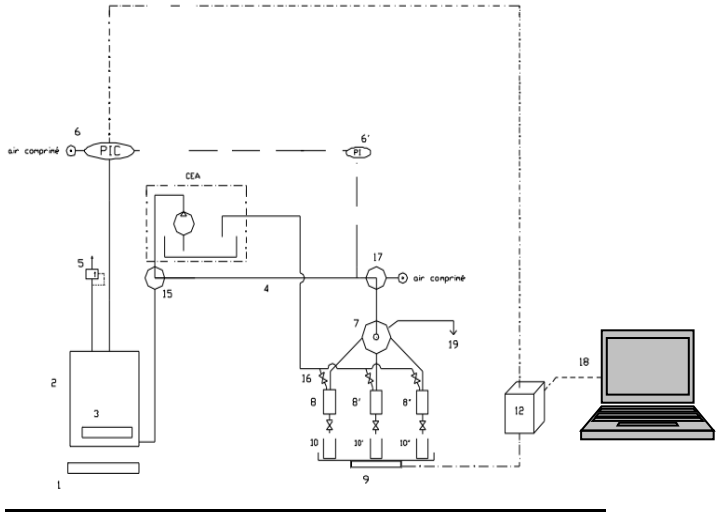
I. INTRODUCTION

This paper proposes to study the influence of particle properties on cake filtration properties. Calcium carbonate can precipitate under multiple forms: plates, cubes, spheres, needles. These forms are obtained thanks to different precipitation conditions. A software developed with Oxford Instruments named INCA Future, can determine all particles properties, shape factor distribution included.
Compressibility and cake resistance will be measured thanks to a device designed at the French CEA. The device can measure cake resistance in a few minutes and requires low amounts of solid (1g per measure). The test can be led at different pressures, from 0 to 10 bars. It allows a wide range of pressure to measure compressibility.

II. METHOD

To study the influence of the particle's shape and size distribution on cake resistance, a particle that can precipitate under multiple forms was needed. An investigation was led and it appears that calcium carbonate is the perfect match for that kind of studies. It is harmless, the precipitation conditions are easy to meet and four forms can be obtained (1).
The precipation done, INCA Future software gives, thanks to MEB analysis, the particle distribution and the shape factor distribution. The cake resistance and compressibility are measured thanks to a minitest of filterability presented below (Figure 1).
A new model based on physical properties of particles is also proposed.

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1. Magnetic stirrer
2. Vessel V = 400 mL
3. Magnet bar
4. Sampling tube 4-6mm PTFE
5. Safety valve (7 bars)
6. Pressure sensor
7. Cells/Eptying Valve
8, 8', 8'' : Filtration cells
9 : Weighing sensor
10, 10', 10'' : 100 mL becker
11 : Computer
12 : Electric box
13 : Filtration data acquisition software
14 : treatment software
15 : 3-ways valve for cell selection
16 : purge valve
17 : Air valve
18 : USB link
19 : Emptying hole

Figure 1 : Minitest of filterability

A MATLAB simulation is able to predict filtration properties of a suspension. These calculations will be compared to the experimental results.

III. RESULTS

Four forms of calcium carbonate were obtained: cubes, spheres, plates and needles. The particles size distribution and shape factor distribution are perfectly known. Cake resistance value for these cases are calculated and measured:

	Calculation	Measure
Alpha (m/kg) 1 bar	2,87 e+09	2,71 e+09
Alpha (m/kg) 3 bar	4,68 e+09	4,03 e+09
Alpha (m/kg) 5 bar	5,89 e+09	5,81 e+09
n	0,45	0,46

The deliquoring time is also calculated thanks to the previous measurements:

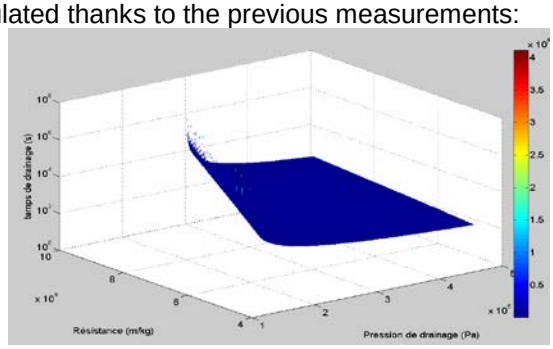


Figure 2 : Deliquoring time for a target of 22% of humidity for cubic shape of calcium carbonate

The calculation is able to predict filtration time needed to reach the target of humidity. It also gives the domain of filtration and deliquoring pressure where it can be obtained.

IV. CONCLUSIONS

The filtration properties and deliquoring abilities can be predicted thanks to the computation. Multiple shapes have been tested. The most influent factors on these parameters have benn highlighted : diameter, standard deviation of the distribution and shape factor.

V. REFERENCES

R.Beck, Influence of crystallization conditions on crystal morphology and size of CaCO3 and their effect on pressure filtration, AIChe Journal, 2012.

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