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A SIMPLE AND LOW COST TECHNIQUE FOR DETERMINING THE GRANULOMETRY OF UASB SLUDGE

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ABSTRACT

Four techniques (microscope sizing, calculation from settling velocities, image and laser analysis) are available nowadays for determining the particle size distribution of UASB sludge. These techniques present however the disadvantage to be either tedious, poorly precise or expensive and hardly applicable in full scale treatment plants. There was then the need for a simple and low cost technique. In this study, a granulometry procedure based on manual humid sieving was evaluated. It was shown that no solid loss occured during the screening and that the particle size profiles were reproducibles when performed with sludge samples of 5, 10, 25 and 150 mL, but not 1 mL. Only the results between 10 and 25 mL were however fully identical. It was shown also that the sieving could be performed on sludge samples stored for as long as 50 days at refrigerator temperature and

millimeters. Actually, as individual cells and granules have similar densities, the greater settling velocity of the latter is only related to its larger particle size (Schmidt and Ahring, 1996). The study of this phenomenon has lead to the development of several techniques for characterizing the resistance of the granules (Pereboom, 1997), their porosity (Alphenaar *et al.*, 1992), settling properties (Andras *et al.*, 1989), bacterial composition and organization (Dubourguier *et al.*, 1988), activity (Dolfing and Bloemen, 1985), nature and composition of exopolymers (Grotenhuis *et al.*, 1991a), as well as their size distribution. This last parameter is particularly useful for studying the physico-chemical factors promoting sludge granulation (i. e. trace metal and calcium concentrations, upflow velocity, organic load, addition of inorganic carriers or crushed granules, etc).

To date, four techniques are routinely used to determine the particle size distribution of UASB sludge. Two of them consist in the direct size measurement with a microscope of at least 100 sludge granules immobilized in a petri dish. This can be done either manually with a Porton graticule in the ocular or automatically using image analysis and a computerized data processing (Hulshoff Pol, 1989; Dudley *et al.*, 1993). The third method is indirect and consists in determining the settling velocities of a sludge sample and to extrapolate the belonging to the "Cervecería Cuauhtémoc Moctezuma" brewery group. The plant is located at

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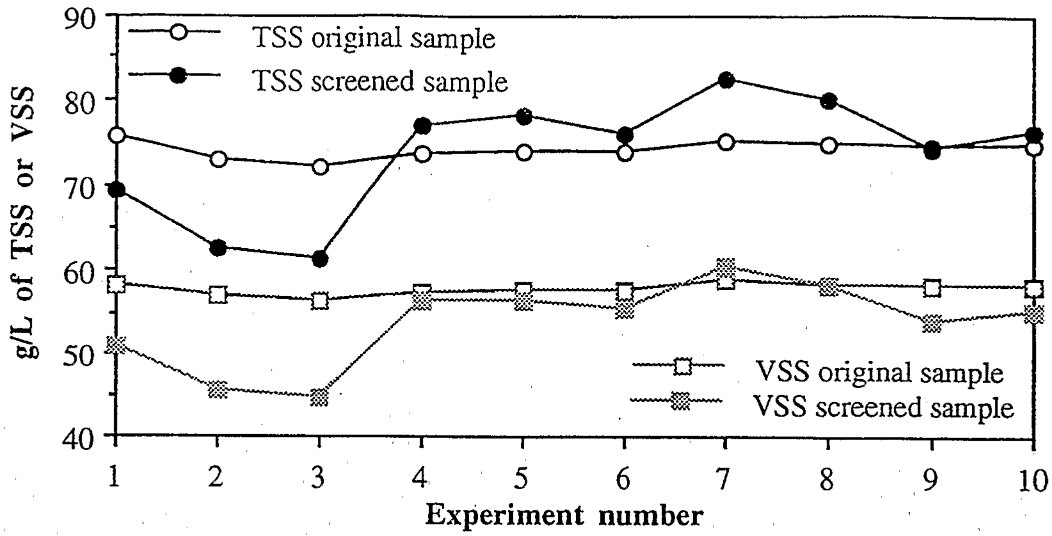
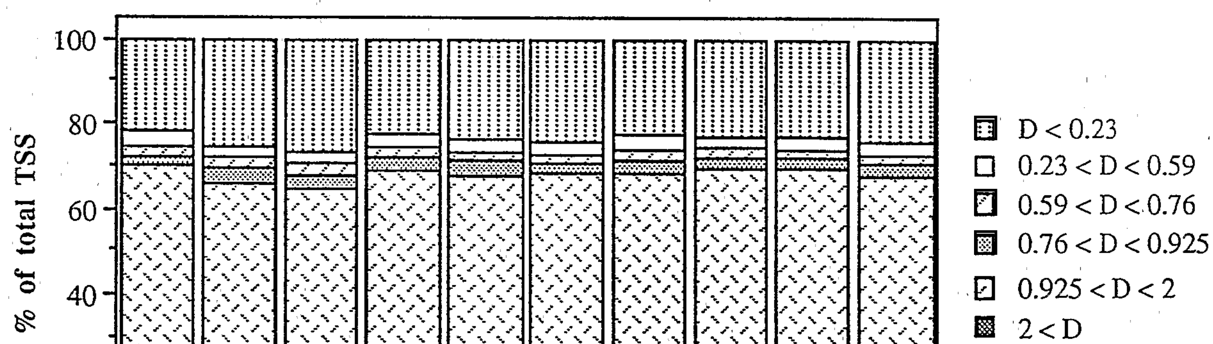
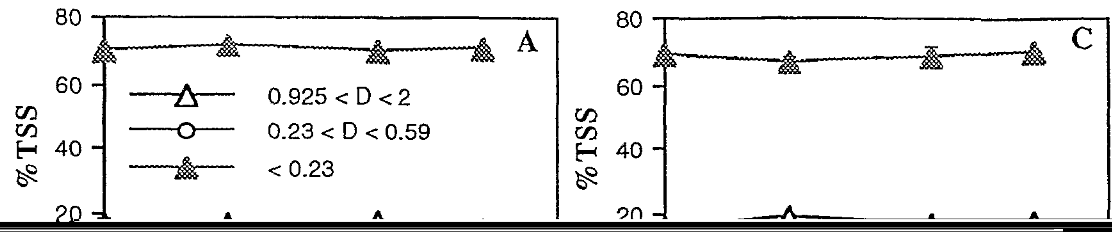


Figure 1. Values of the TSS and VSS obtained for ten sieved and unsieved sludge samples



and < 0.23 classes. In that case, the difference may be related to the fact that despite of using more phosphate buffer for washing the granules when screening 150 mL (1600 mL against 700 for 25 mL of sample, 300 for 10 and 150 for 5 mL), the ratio of buffer volume to sample volume was only of 10 compared to 28-30


80
60
40
20
% TSS
A
0.925 < D < 2
0.23 < D < 0.59
< 0.23
C

Practical application of the Technique

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54 days the granulometry of a 2 L UASB reactor sludge fed with cheese wastewater and operated at an upflow velocity of 0.5 m/h. As can be seen on figure 4, the sieving technique permitted perfectly to visualize (1) a segregation of the sludge bed, the biggest granules being more abundant at the bottom and the smallest at the top, and (2) an increase of the fraction corresponding to the biggest granules along time, both at the bottom and top of the sludge bed. The techniques allows also to compare easily the granulometry of sludges from different sources (data not shown).

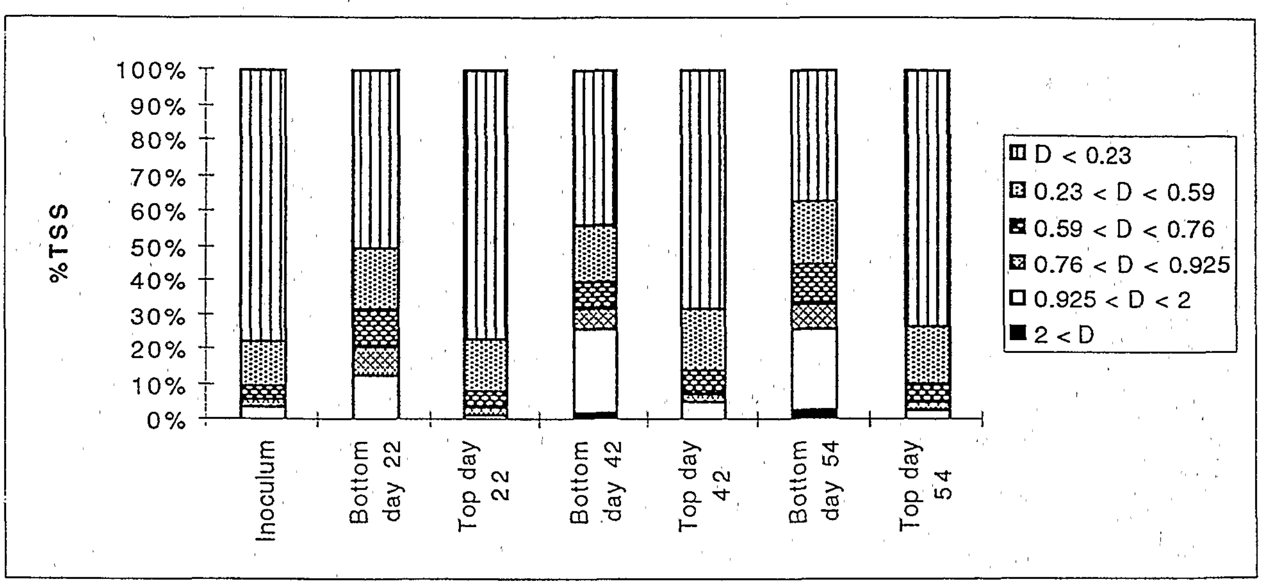

Figure 4. Evolution of the granulometry at the bottom and top of the sludge bed of a lab scale UASB reactor fed with cheese wastewater

CONCLUSIONS

The sieving technique can be used to determine the granulometry of UASB sludge. All screening performed with 5, 10, 25 and 150 mL will give reproducible results while only screening performed in the range of 10-25 mL will give identical values. In order to compare the screening done by different laboratories, this range of volume should be prefered. Tap water can be used for the washing and backwash operations since it yields identical results with phosphate buffer. The sludge can be stored up to 50 days in a refrigerator without any impact on its particle size distribution. Since screening and image analysis gave uncomparable distributions, size integrity can be demonstrated. Such apparatus would require nevertheless probably higher sample volumes.

AKNOWLEDGEMENTS

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