

## **Effect of activated sludge characteristics on the fouling frequency of a single stage mechanical dewatering and thermal drying process**

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### **ABSTRACT**

On the wastewater treatment plant of the Monsanto Europe site in Antwerp, Belgium, two dewatering devices are used to dewater the excess wastewater sludge: (1) filter presses yielding a final cake dryness of typically 35-40% DS, and (2) a single stage process combining mechanical dewatering and thermal drying in a single compact machine yielding a significant higher final product dryness of 85-95 %DS. It is obvious that a higher capacity of the latter results in less volume of waste generated.

Over the years, the operational team has been facing here two main bottlenecks, namely (1) high vibrations of the solid bowl decanter centrifuge and (2) periods of frequently fouling around the centrifuge cake outlet or somewhat further in the flash drier.

The vibrations of the centrifuge were reduced (and so the first bottleneck eliminated) by simply reducing the centrifuge bowl speed in steps of 100 rpm from historical 3165 rpm to 2880 rpm. It was shown that the final reduction step from 2980 rpm to 2880 rpm resulted in a significant and spectacular reduction of the vibrations baseline. Besides this huge positive improvement, the lower G-force (83% for 2880 rpm compared to 3165 rpm) did not show any negative operational impact.

After setting the centrifuge bowl speed at 2880 rpm, fouling of the system became the next bottleneck. This issue seems harder to be resolved. From time to time, frequently (daily) product build-up at the centrifuge cake outlet or further in the flash drier is experienced. In these periods, sludge feed towards the centrifuge has to be stopped frequently and flushing to be started to remove product build-up.

By extensive research over the years, it was shown that the plugging frequency seems to be related with the 'kind' of activated sludge being made in the aerators of this WWTP. The nature of the activated sludge is mainly determined by the sludge settleability and the inorganic fraction of the sludge flocs. This fraction varies significantly over time for this particular WWTP as a result of varying calcium concentrations in the wastewater: periods of 15% inorganic fractions are followed by periods with more than 30% inorganics on the sludge flocs. Sludge settleability varies in accordance with these changes in inorganic fractions, with a higher inorganic fraction resulting in a heavier floc and so a better sludge settling ability. It was shown that sludge comprised of higher inorganic fractions results in a higher chance for product build up in the system.

As a result of the hot gasstream (260 °C) surrounding the centrifuge cake outlet, it is impossible to take cake samples during operation. Although, cake analysis would be preferable to know how cake composition is changing in the field, and to possibly find relations with the product build-up. That's why the operational team started with regularly executing spin tube tests in the lab on centrifuge feed samples taken in the field. Those spin tube tests simulate the centrifugal dewatering by compaction in the field. Based on a one year follow up, this research shows that the inorganic fraction of the sludge flocs has a significant impact on the cake dryness obtained by centrifugal compaction, with a higher inorganic fraction yielding a drier cake.

Taking into account the fact that activated sludge goes through a sticky phase while being dried (somewhere in the range around 40-50%DS, depending on the literature source), this implies that the centrifuge cake dryness determines timing and place in the system where the sludge is going through the sticky phase. Hypothesis is that a too dry cake leaving the decanter centrifuge results in product

build up because in that case the sludge is going through the sticky phase earlier in the system which seems to be more sensitive from a product build up point of view; for example at the point where the cake particles leaving the centrifuge with high velocity hit the centrifuge casing for the first time.

In the field, centrifugation conditions are being changed now to make the centrifuge cake again somewhat less compact and so wetter in periods of sludge characterised by a higher inorganic fraction, in order to verify the impact on product build up. Besides, design of experiments are performed in the lab to understand effects of conditioning additives on cake compactibility.

The paper will discuss the findings mentioned above, and first results of the changing centrifugation conditions with changing sludge characteristics.

## **KEYWORDS**

Wastewater sludge, inorganic, centrifugal dewatering, thermal drying, fouling