HIGH PERFORMANCE SLUDGE DEWATERING FOR DRINKING WATER PLANTS WITH THE BUCHER HYDRAULIC FILTER PRESS

Jean-François Mischler
Bucher Unipektin AG

Eric Judenne, Matthieu Delahaye, Jean-Michel Faccioli
Degrémont SAS

Corresponding Author : Michael Huppert Tel. +41 44 8572 669 Email
michael.huppert@bucherunipektin.com

Abstract

Why a Bucher Hydraulic Filter Press for Sludge Dewatering?

Bucher presses provide a new superior technology for processing municipal and industrial sludges to yield filter cake with the lowest possible moisture content. The complete press is slowly rotated in order to loosen and crumble the filter cake thus achieving a superior performance and efficiency. Using common additives, sludge may be mechanically dewatered to the limit that is technically possible. With the Bucher press, the maximum possible dry substance content is achieved for raw, digested, thermally or chemically treated waste water sludges and this is also the case for all drinking water sludges.

What are the performances and key benefits of a Bucher Hydraulic Filter Press on drinking water sludge?

The dewatering of drinking water sludges is a worldwide challenge, as drinking water sludges generally provide only limited results on decanters and filter presses. They usually only work well when the lime amount in sludge is over 20%. A good performance is furthermore linked to a low algae content of treated surface water.

With the Bucher press one attains the maximum dewatering and thus achieves the best possible results in dry substance content of the dewatered filter cake. In many cases the Bucher HPS press is able to dewater drinking water sludges to over 40% DS without lime addition.
The Bucher press allows to reach the best possible dewatering performances on all kind of drinking water sludges with all usual conditioning methods even for desalination plants or during algae periods.

Lime addition is not a must for the Bucher HPS press and by avoiding lime addition the sludge cake volume can possibly be halved in comparison with other technologies.
The sludge conditioning therefore can be adapted to the final sludge disposal routes and not the other way round. Options are for instance landfill (cover layer) and cement works as well as outlets for spreading and composting.

The paper highlights as well first industrial scale results of new installations of Bucher HPS presses in drinking water plants.

Keywords

Desalination, Dewatering, drinking water, dryness, piston press, sludge, Bucher HPS, Dehydris™ Twist.

Introduction

Sludge management is becoming more and more a major issue for drinking water plant operation. Sludge discharge in the river, sea or sewer is or will be regulated in the future, and operators have to find new disposal routes with less impact on our environment. Drinking water sludge dewatering and disposal are becoming an important part of drinking water production costs, with growing disposal costs.

Conventional technologies face process limitations.
In most cases centrifuges can only be operated with polymer and filter presses need to be operated with pre-liming. Centrifuges don't allow to reach high DS contents and chamber filter presses requires operator's intervention at discharging.

Table 1: Common achieved performances of dewatering systems

Type of sludge	Conditioning	Belt filter dryness	Centrifuge dryness	Chamber Filter Press dryness
Drinking Water (moderately concentrated water)	Polymer Lime	13 – 20% -	15 – 22% -	- 32 – 38%
Seawater desalination	Polymer Lime	- -	20% -	- 25 – 45%

Bucher dewatering

The Bucher Hydraulic press is a fully automatic dewatering unit based on filtration principle were dewatering pressure is given by a hydraulic moving piston.

The Bucher press allows to reach the highest mechanical dewatering levels and can be used with all kind of conditioning, polymer or mineral. This equipment is able to shift from one conditioning to the other without any adaptation except selection of new settings at the control panel. The Bucher press offers the best performance and a huge flexibility in term of performance and sludge disposal routes.

The dewatering equipment is simple and maintenance friendly. There is no high pressure sludge pump and no lime-milk production needed. The sludge press is easy to operate and fully automatic.

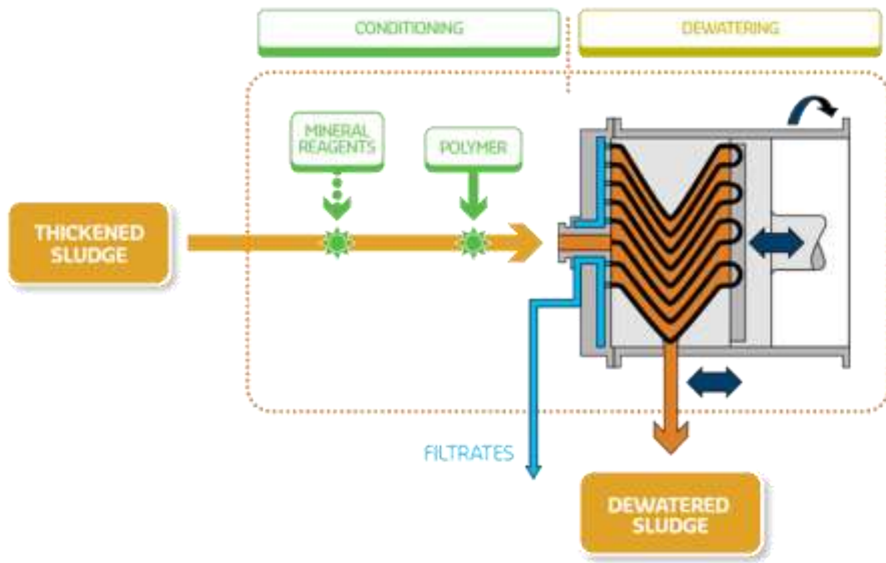

Figure 1: The Bucher press dewatering workshop also called Dehydris™ Twist in Degrémont product catalogue

Bucher dewatering process

The technical concept of the BUCHER piston press is based on 2 principles:

- applying pressure to the sludge in a pressing chamber via a hydraulic piston
- shearing of the sludge and permanent renewal of contacts filter medium / flocculated sludge with the rotation of the press combined with the movement of the piston

The time of dewatering is between 2 and 3 hours depending on the type of sludge to be dewatered and on the performance required. This flexibility is one of the characteristics of this process with two possible operating modes, one for getting dehydrated sludge with high dryness at nominal flow and the other favouring the mass flow rate which can be increased up to 50% compared nominal production with lowered sludge dryness.

The press cycle is divided into 3 phases (figure 2):

- filling with preliminary pressing
- pressing and loosening
- dewatered sludge discharge

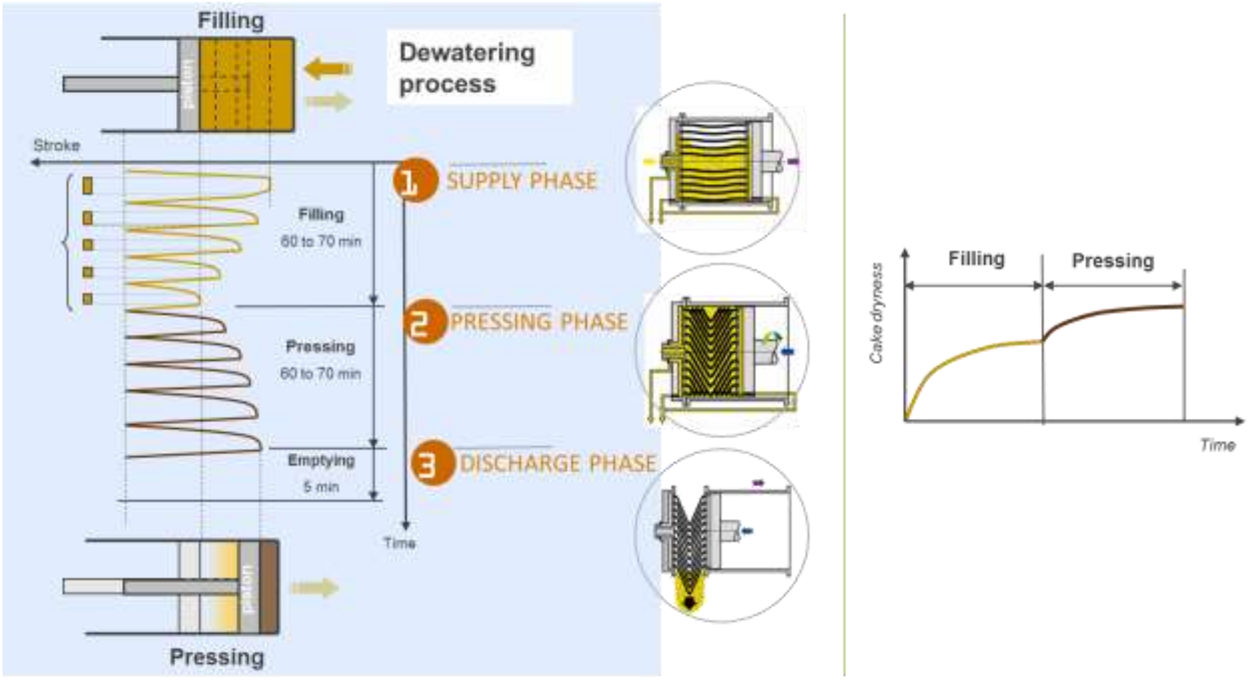

Figure 2: **Bucher HPS dewatering process**

Achievement of best possible performances for mechanical dewatering

Due to the specific dewatering principle of the Bucher press the highest possible dewatering degree is achievable with full automation.

Very high DS contents and automation is achieved even without lime addition.
The achieved performances and avoidance of lime addition to the sludge cake will almost allow to half the sludge production compared to other technologies.

The significant reduction of sludge cake is not the sole advantage of the technology. The filtrate is also very clear with a Capture rate over 99% and less than 100 mg/L suspended solids.

This means less load in waste water from dewatering workshop or less material returned to sludge tank if filtrate is recirculated.

Here under will follow table 2 and some pictures of sludge cake (figure 3) produced on drinking water plant equipped with Bucher presses in comparison to other technologies.

Table 2: Achieved performances on drinking water plants using Bucher presses

Site	Conditioning	Existing technology	HPS
Morsang sur Seine 6 month industrial size test in parallel to filter press	Unit type	Filter press	HPS 3007
	Polymer	Not possible	30 – 43%
	Lime 25% CaO	29 – 38%	35 – 47%
Symeval (France) New plant	Unit type	None	HPS 3007
	Polymer	-	35 – 42%
	Lime	-	Not tested
Conza (Italy) Plant upgrade, prior installed centrifuges	Unit type	Centrifuge	HPS 3007
	Polymer	16 – 20 %	30 – 40%
	Lime	-	Not tested
Perth (Australia) Desalination plant	Unit type	Centrifuge	HPS 207 pilot unit
	Polymer	20- 22 %	40 – 48%
	Lime	-	Not tested

Conza Italy
Cenrifuge vs HPS

Morsang sur Seine, France
Filter press vs HPS

Symeval, France
only HPS, 2 different period

Figure 3: Sludge cake aspect on plants using Bucher press and comparison to other technologies

Tests and performance on DW sludges

1.1 Full scale tests with Degrémont on Morsang sur Seine (France) Drinking Water plant

In cooperation with Degrémont, Industrial scale test with a HPS 3007 piston press was conducted on the drinking water plant of Morsang sur Seine in France in 2012.

With a hydraulic capacity of 225,000 m3/day the drinking water production plant of Morsang sur Seine (figure 4), operated by Lyonnaise des Eaux France, is one of the key pieces of the production of drinking water for south of the Isle of France with the possibility to feed 1.2 million people.
Since its construction in 1970, the plant Morsang sur Seine has evolved by incorporating the innovations of Suez Environment and through engineering by DEGREMONT.

The plant is fed by water pumped from the Seine upstream of the dam in Morsang / Seine. The problematic of the water treatment is related to the turbidity, the presence of pesticides, micro pollutants and TOC. The diagram of the plant (Figure 5) includes a pre ozonation and 3 processing lines each comprising a decanter and two floors of activated carbon filters in spaced grain ozone disinfection.

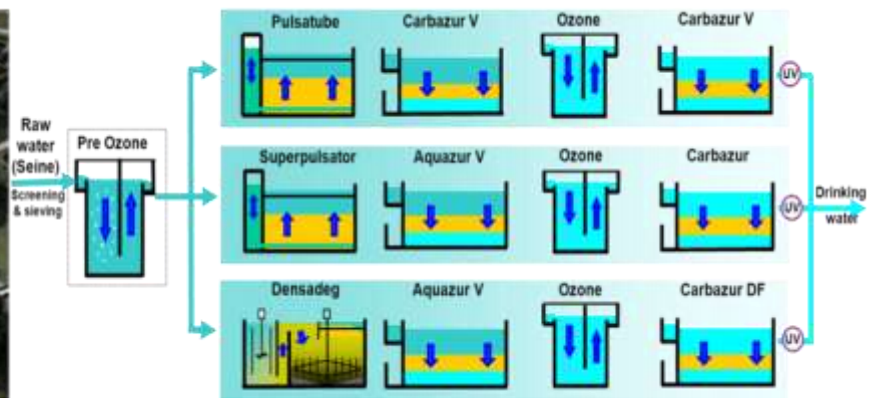

Figure 4: Plant of Morsang sur Seine – France

Figure 5: Morsang sur Seine plant - Water treatment diagram

The coagulation is performed with an aluminium salt. Injections of activated carbon powder are made depending on pollution.
The treatment process includes a sludge thickener which takes sludge settlers of the lines 1 and 2 (Pulsator and Superpulsator) while sludge the line 3 (Densadeg) are sent to the storage, Densadeg includes the thickening step.
The wash water filters are recycled to the treatment at the decanters.

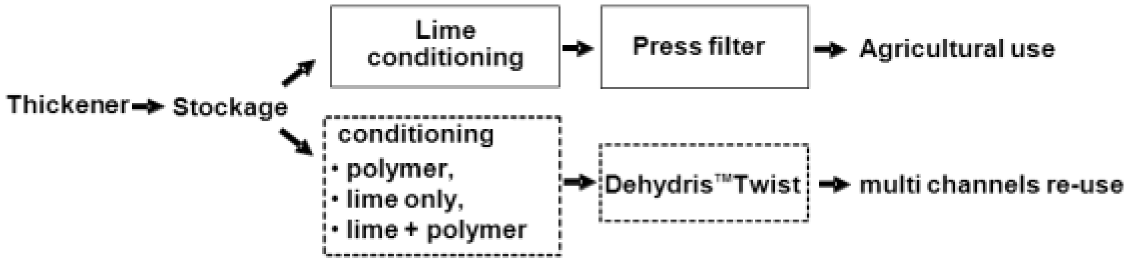

Figure 6: Morsang /Seine sludge diagram with the industrial Dehydris™ Twist HPS 3007

The dewatered sludge from the filter press is conditioned by adding milk of lime. The production of sludge varies from 4,000 to 6,000 t per year with a dryness average of 32%. These sediments are revalorized in agriculture.
During the tests, the sludges from the pilot plant Dehydris™ Twist were re-used, depending on conditioning applied in agriculture or composting.

1.1.1 Industrial pilot test results

Figure 7: Dewatering workshop with the filter press and the Bucher press

The piston press (figure 7), has a capacity of 150-200 kg of dry matter per hour and was fed by the thickened sludge from the storage tank.

300 tests were made over the period with an average time of 2 hours per dewatering cycle. The rate of polymer addition averaged 5.5 kg of active matter per ton of sludge dry matter.

The dryness with polymer conditioning was about 42% and 5 points higher (47%) in lime conditioning (CaO/DS = 20%).

The following curves (figure 8) represent the evolution in the dryness during the dewatering process obtained on several tests carried out on sludge conditioned with the polymer or lime with or without a polymeric flocculation following.

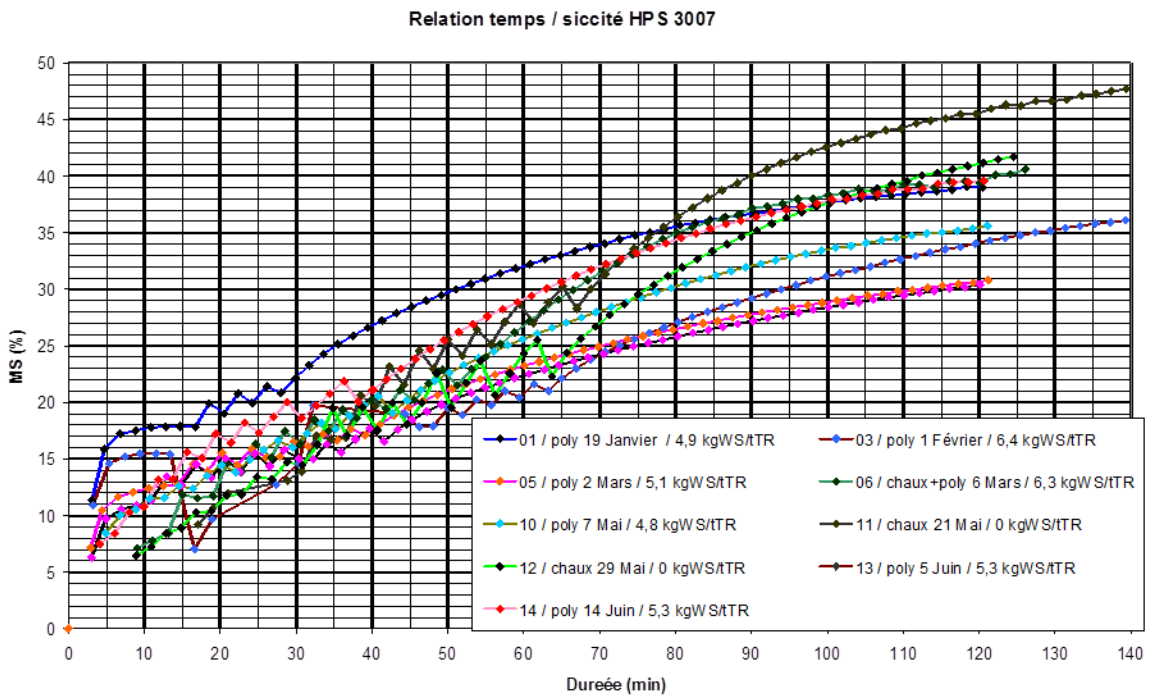

Figure 8: **Dryness during the dewatering cycle**

The end filling of the press is shown on these curves (figure 14) with the end of the series of dryness peaks. Following the trial period, we find that the filling time of the press is between 30 to 60 minutes depending of sludge concentration, and that variations in achieved dryness appear while the treatment rates are approximately the same.
The operating parameters and recording performance filter press, operating in parallel, have allowed interpreting these differences.

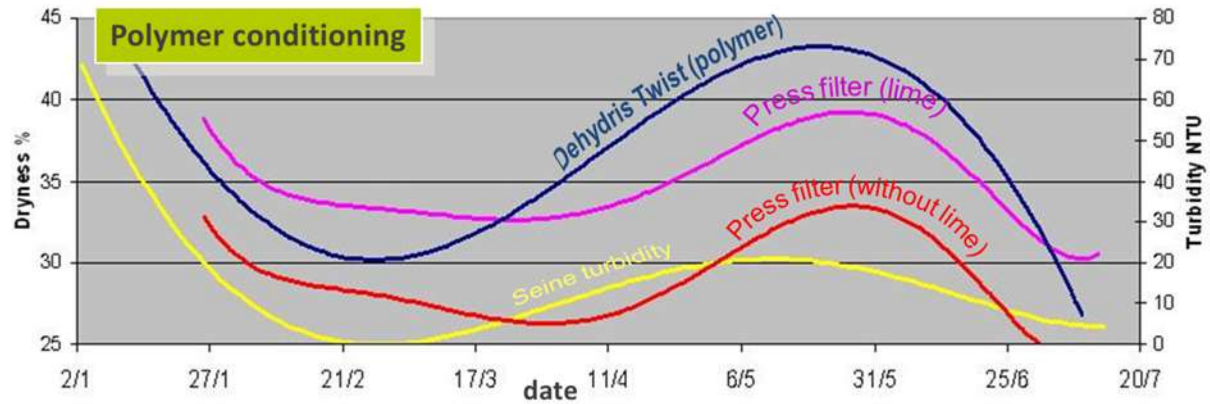

Figure 9: **Dryness comparison depending on the turbidity (polymer conditioning)**

The above curves (figure 9) compare the dryness obtained with the Bucher press with those of the plant's filter press, depending on the change in turbidity of the Seine.
The sludges feeding the piston press were conditioned with polymer, while those dewatered on the filter press was conditioned with lime.
To get a more accurate comparison of performance, the dryness obtained with the filter press was calculated by removing the lime implemented in the conditioning (red curves).

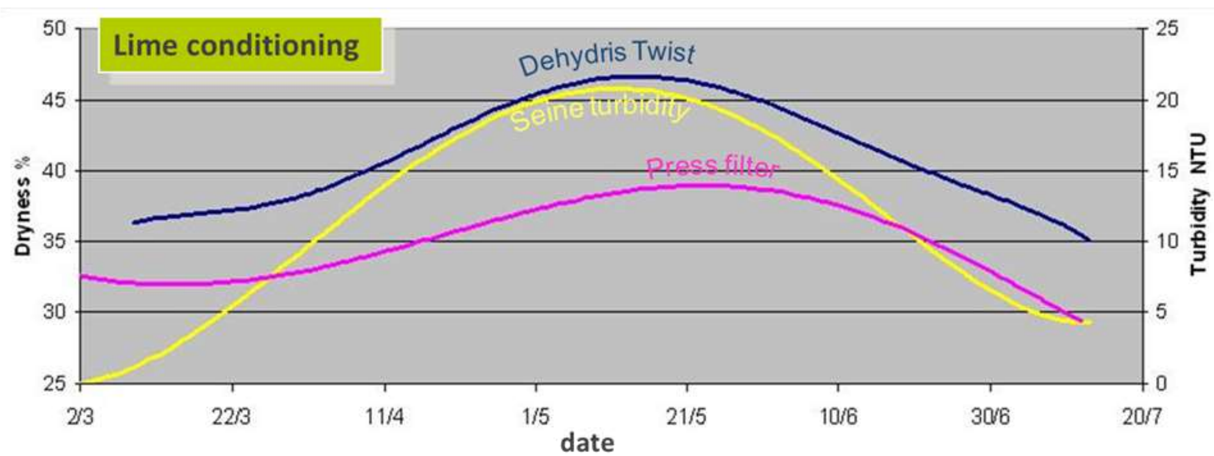

Figure 10: **Dryness comparison depending on the turbidity (lime conditioning)**

In figure 10, the 2 equipment is supplied with the same sludge conditioned with lime.
The curves confirm the influence of turbidity on the dryness which was achieved on the equipment. The dryness of the piston press is always higher than the one obtained on the filter press with the same conditioning.
These industrial trials confirm the innovative aspect of this technology, by alternating pressure and loosening on the cake, outperforms conventional dewatering equipment approaching dryness limit of the sludge.

1.2 Pilot test on sea water desalination sludge

The plant of Perth (figure 19) produces drinking water from seawater with a flow rate of 143 700 m3/day.

Figure 11: Perth plant

Water line description (figure 12):
After screening and pumps, acidification with H_2SO_4 the coagulation is performed with FeCl3 and organic coagulant aid. 2 banks of 12 pressure dual media filters for a total flow rate up to 14 000 m3/h. To reduce the salinity and bromide, the reverse osmosis treatment is performed with double pass; a bank of pressures exchangers ERI is installed. A remineralisation is then carried out by $Ca(OH)_2$ injection with final injection of CO_2.

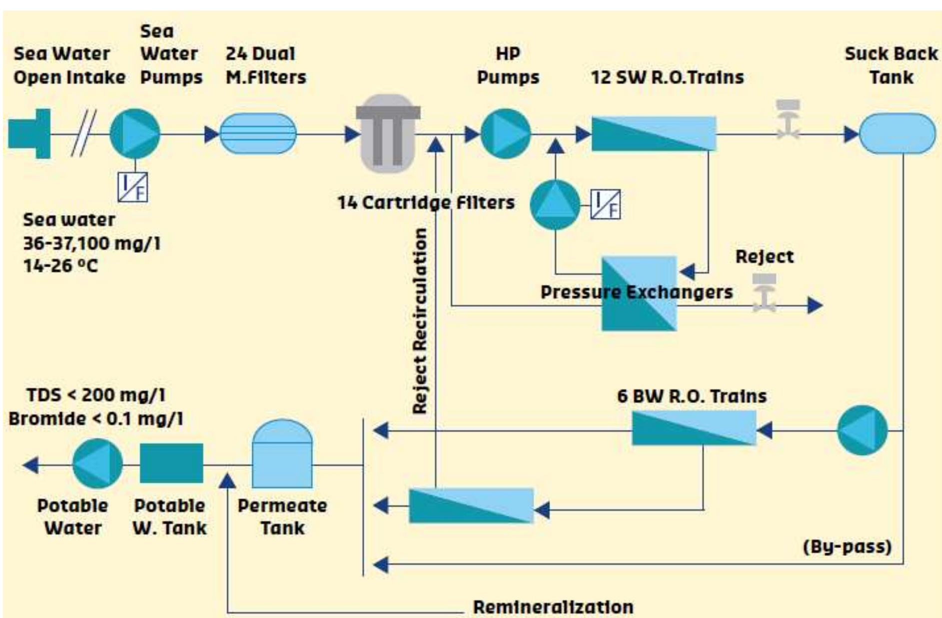

Figure 12: Perth plant diagram

On Perth plant (like for other desalination plants with R.O.) the sludge treatment concerns the residues of the pre-treatment. The residues cannot return to the sea because they mainly impact the flora with the turbidity by disturbing the photosynthesis. After coagulation, settling and thickening the residues are dewatered for use in agriculture spreading or backfill for landfill.
The environmental dimension is solved, but the economic aspect is relation to transport of the sludge volumes need to be improved. Higher performance of dewatering will reduce the cost. (figure 14).

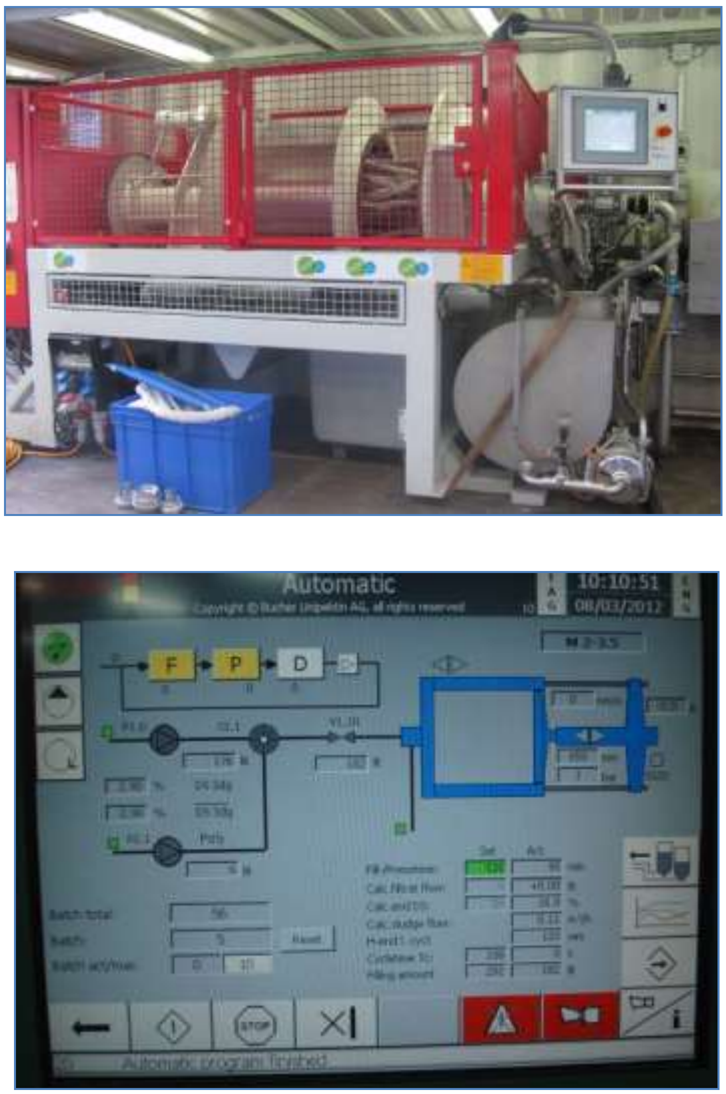

Figure 14: Bucher pilot piston press HPS 207 & touch panel

Main trial result of Perth sludge is shown in figure 15, Dehydris™ Twist cake dewatered up to 46-50% DS is 24-28% higher than centrifuge cakes (22%). The cake volume reduction is up to 58%

Figure 15: Dryness during the dewatering cycle

Conclusions

Significant improvement in dewatering performance has been obtained on all sludge tested with polymer conditioning only.
Drinking water sludges, coming from settling tanks and filter backwashes, could be dewatered to final dry solids contents of up to 42% with 5 kg AM/tDS polymer dosage; moreover, without polymer but with 25% CaO/DS lime conditioning, 5 to 8 additional points of dryness were obtained with the Bucher press in comparison to the existing filter presses operated of the plant.
Desalination sludges, coming from backwashes of sea water pre-filters before RO, could be dewatered only by adding polymer (6 to 7 kg AM/tDS) to final dry solids contents of up to 46%; in comparison to the centrifuge operated on the plant, an increase of 22 to 28 points on sludge dryness was observed.

In summary, on drinking water or desalination sludges, the dryness obtained with Bucher Presses is higher than with conventional dewatering technologies.

These test performances are also confirmed by two installations realised by Degrémont and now in operation on drinking water plants in France and Italy.

Sources : E. JUDENNE*, M. DELAHAYE**, JM. FACCIOLI*** (2014)
Dehydris™ Twist, a boosted dewatering workshop with a piston press – Performances on Drinking Water sludge and Desalination sludges.

* Degrémont SAS / Technical Department, Paris La Défense, France

**Degrémont SAS / Innovation Department, Paris La Défense, France

***Degrémont SAS / Techinical Department, Paris La Défense, France