Technical Paper

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20.4.2016

Subject: **New Process Water Treatment System VoxSton**
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Date: April 20, 2016

Description of VoxSton

A new industrial process water treatment system VoxSton developed by SansOx Ltd. and RannanTeollisuuskone Oy is presented in this paper. The system consists of two centrifugal separators, a screw separator and two vortex flow flotation units. It can separate the solids like fibers out of the sludge and press them to dry matter content of 30 percent, and clean the sludge water for recycling and discharge to nature.

The first test runs have been conducted process phase by phase with real pulp and paper process sludges successfully. The special feature of the system is that the industrial sludge can be treated in the most cases continuously or daily basis directly from the liquid outlet to finish without equalization and precipitation.

The new system saves in energy and space as well as in operational costs roughly 50 percent compared to present advanced systems. The capital costs are estimated to be lower too.

The concept of the new Pulp & Paper process water treatment called VoxSton consists of the following phases and devices:

1. SaoxFuge centrifugal separator in one or two steps with a screen shelter flange for enhancement of solids content from 0.5 to 5 percent
2. Milston screw separator for solids separation of dry matter content up to 30 percent
3. VoxFlotation vortex flotation process for floggulation, flocs separation and cleaning of the water coming from SaoxFuge and Milston separation

The entire concept is presented in Fig. 1 and a comparison of the VoxSton and present advanced process water treatment systems is presented in Table 1.

1. SaoxFuge Centrifugal Separator

Separation efficiency of SaoxFuge is based on centrifugal force and sediment effect that depends on the liquid viscosity and the specific gravity difference. The liquid flows a spiral path among the SaoxFuge pipe and a strong centrifugal force is created. The centrifugal acceleration depends on the flow speed and curve radius, it could be up to 1 000 G. The liquid flow in the SaoxFuge can be pressurized up to 10 bar that makes the flow smoother and reasonable high flow speed is possible. The SaoxFuge Separator is presented in Fig. 2.

Juhani Pylkkänen

20.4.2016

2. Milston Screw Separator

Milston is a compact and efficient screw separator verified with various sludge and slurry separation. It's available as a fixed installation and mobile applications, manual or completely automated. Particularly, Milston products are robust and reliable, easy to maintain and keep clean by internal washing system. Milston Hero 1 and its test results of P&P sludge separation are presented in Fig. 3.

3. VoxFlotation

Vortex Flotation Separation developed by SansOx is a unique separation method in which the liquid flows with the particles continuously in a vortex path, the gas bubbles are formed in inlet of the liquid flow and in the vortex flotation flow, the bubbles spin and cross the vortex liquid flow in optimal angle, the particles in the vortex flow stick gently on the spinning gas bubbles and are transferred to the cell surface.

The Vortex Flotation Separation by SansOx is named as **VoxFlotation**. The concept and principle of the **VoxFlotation** are presented in Fig. 4 and 5.

The liquid is treated before the vortex flotation phase by the OxTube of SansOx, Fig. 4 and 6. The treatment consists of gas and chemicals feed and mixing, gas dissolving and additional compressed air feed if needed for additional air bubbles. The treatment is done continuously and fast in terms of seconds by the OxTube process that mixes chemicals e.g. coagulants, dissolves gases e.g. oxygen in to the liquid, and generates lots of flocs and micro bubbles of air and reaction gases directly in to the flowing liquid.

The superior performance of VoxFlotation is based on its following features:

- The liquid is flowing without stopping through mixing, dissolving and flotation separation that increases performance and decreases energy consumption.
- Chemicals are mixed and gases dissolved continuously within seconds directly in to the liquid flow.
- The bubbles are evenly distributed, number of the bubbles is huge and their size is small and controllable.
- There are mixture of air and reaction gas bubbles in the liquid flow that increases separation performance.
- Additional compressed air can be fed in to the liquid flow in order to generate larger bubbles if needed.
- Surface energy of the solid/gas interface is increased by micro bubbles and the spinning effect caused by the vortex flow. Attachment of solid to gas is increased.
- Surface energy of the solid/liquid interface is reduced by gas dissolving which reduces surface tension and viscosity of the liquid, and the attachment of solid to gas is increased.
- The vortex flow turns bubbles and solids towards the main stream that reduces impact of shear and gravitational forces on the detachment.

Juhani Pylkkänen

20.4.2016

- The collection efficiency of the flotation process is increased by high collision probability, small bubble size, and high density of air and reaction gas bubbles.
- The vortex flow keeps the flotation cell clean for longer which reduces service costs
- There are no rotational nor moving elements, e.g. impellers in mixing/dissolving, which reduces maintenance and energy costs.
- The vortex flow prevents growth of bacteria population, BOD, fermentation and sediment retention on the bottom and wall.
- COD is reduced fast by the efficient oxygen dissolving, high oxygen concentration and by the continuous treatment process.

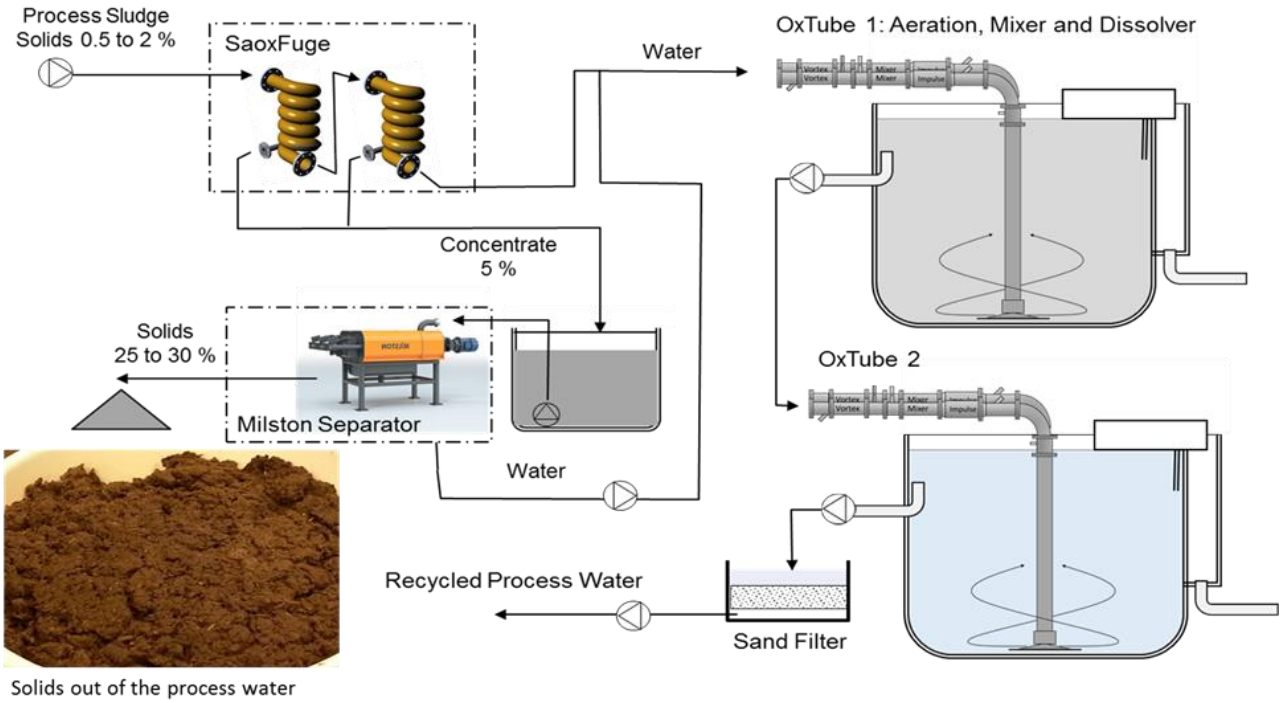

Fig. 1 Conceptual illustration of VoxSton process water treatment. In the most cases the process water can be treated from process outlet to finish continuously or daily basis without equalization and precipitation.

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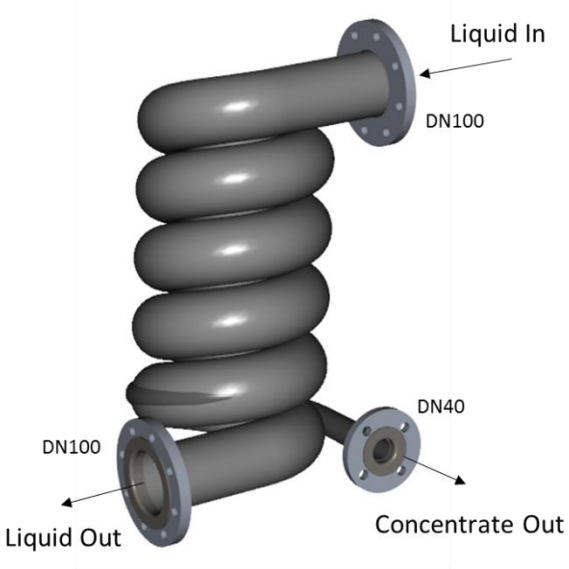

Fig. 2 SaoxFugeDN100 centrifugal separator is simple and reliable, no moving parts. Separation is a continuous and even process

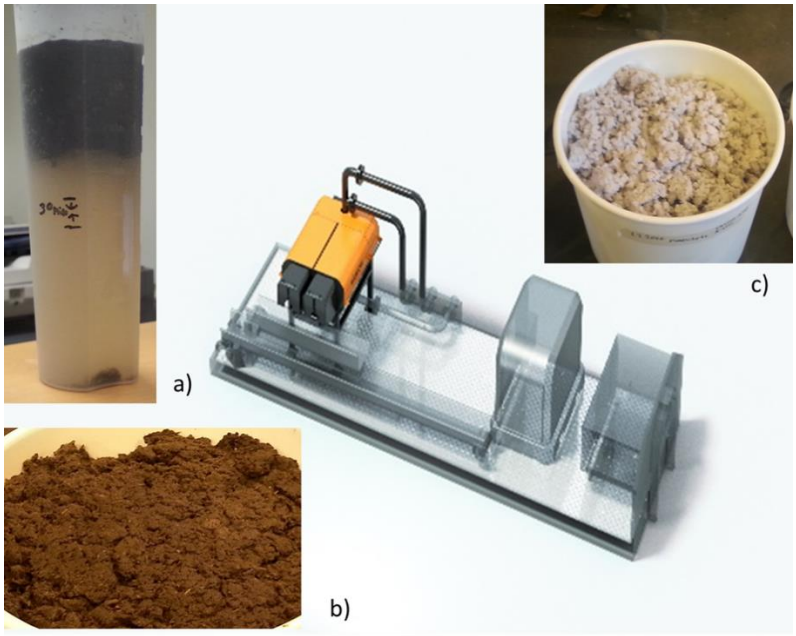

Fig. 3 Milston HERO 1 slurry separation capacity up to 75 m³/h; a) Pulp sludge left above, b) Separated pulp sludge left beneath, c) Separated paper sludge right above

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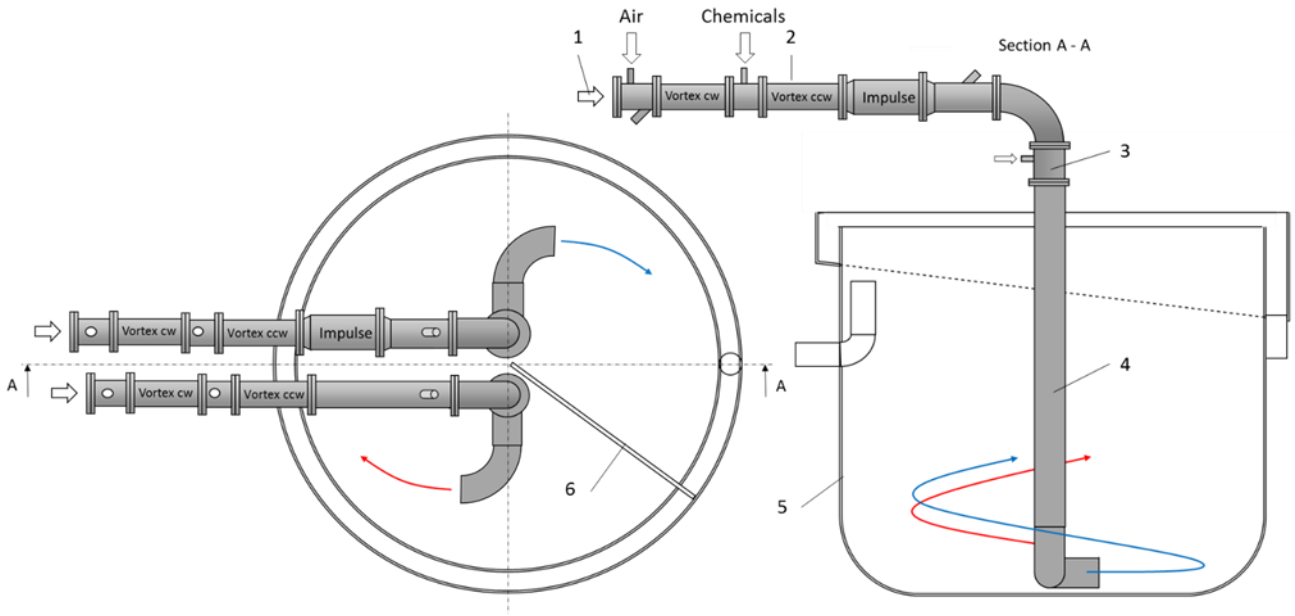

Fig. 4 VoxFlotation Separator; 1.Liquid intake, 2.Feed, mixing and dissolving of additives, 3.Additional flotation gas feed, 4.Vortex flow pipe of the treated liquid, 5.Flotation with round corners, 6.Foam scraping wing with height control

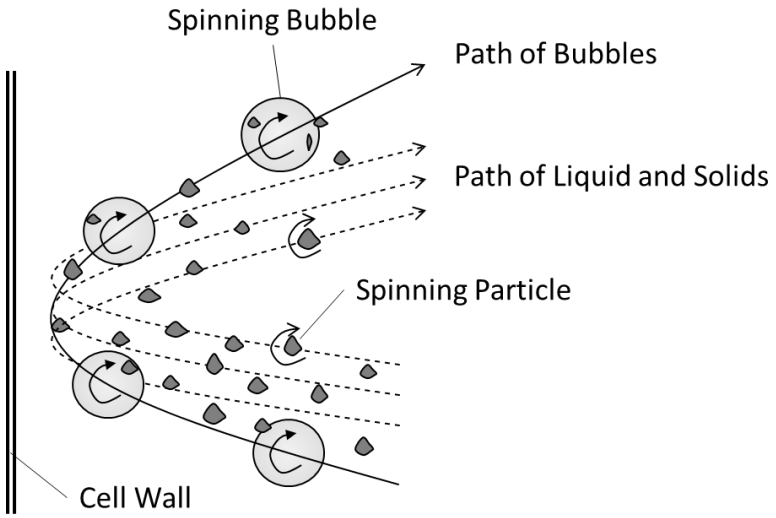

Fig. 5 Bubbles cross the liquid and particles flow smoothly. The vortex flow causes a spinning effect of bubbles and solids that increases attachment performance

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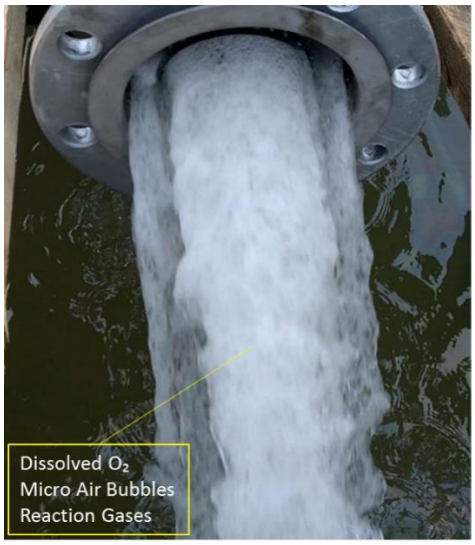

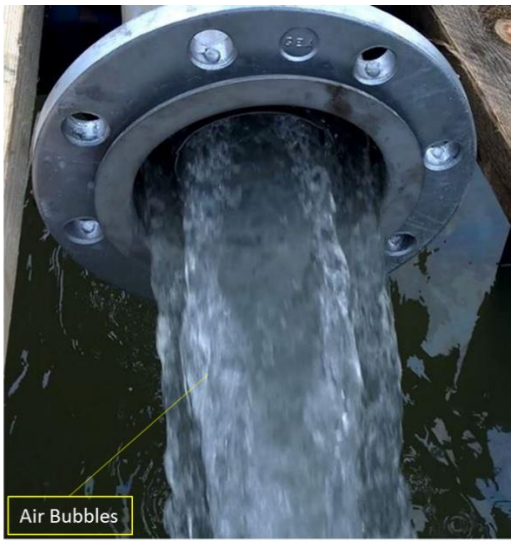

Fig. 6 Left OxTube aerated water flow and right non OxTube aerated water flow. OxTube aeration creates high concentration of dissolved O_2, immediate reaction and huge amount of bubbles of 0.1 mm diameter in average. The surface tension and viscosity of the liquid is reduced significantly.

Table 1 Summary of the comparison of the novel and present process water treatment systems

P&P Process Water of 5 000 m³/d				
	Conventional Process		Novel OxSton Process	
Investment	2.9 to 4.3 M€	580 to 860 €/m³	2.5 to 3.4 M€	500 to 680 €/m³
Operation Costs	1 050 €/d	0.21 €/m³	680 €/d	0.14 €/m³
Maintenance Costs	340 €/d	0.07 €/m³	170 €/d	0.04 €/m³
Less Energy Cons.	7 000 kWh/d	1.4 kWh/m³d	3 600 kWh/d	0.72 kWh/m³d
Space	3 850 m²		1 400 m²	
Less CO_2 + removal	High energy consumption		Low energy consumption	
Odor Control	Difficult		In control by Efficient Oxygenation	
COD and BOD	Slow, high energy consumption		Fast and low energy consumption	

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