Closed Loop Operation with Paques BIOPAQ® ICX in Sunshine Paptech (Sukraft Group), Wada – Maharashtra

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Introduction:

Two primary challenges for the OCC industry is the struggle to produce odour free paper and a persistent obstacle of water disposal due to strict rules of PCB (Pollution Control Board). The wastewater characteristics from OCC mill which does not have biological treatment usually contains high COD, BOD, VFA, TSS, TDS, Calcium, Sulphate, etc. These composition leads to more ground pollution. Therefore, these plants should be operated with ZLD (Zero Liquid Discharge) to avoid water disposal to ground.

In Sunshine Paptech, the effluent generation with one paper mill production of 250 TPD is 2400 m3/d with SCOD concentration of 5000-5500 mg/l and calcium of 550-650 mg/l after Paques BIOPAQ® ICX commissioning. Before the commissioning of BIOPAQ® ICX the paper mill was operating in closed loop without COD removal, resulting in the accumulation of COD and VFA in the loop water. Because of this, an odour was present in the paper that was produced from the mill. Since the mill was operating in closed loop without any treatment, COD, VFA and calcium concentration increased drastically. VFA in the water is major reason for abnormal odour in the paper. In order to control the odour in end product, Sunshine Paptech decided to install Paques BIOPAQ® ICX reactor.

Technology supplied:

Paques supplied BIOPAQ® ICX technology, which is our third generation anaerobic reactor to Sunshine Paptech for handling the nutrient rich water from the paper mill. The BIOPAQ® ICX reactor is an anaerobic reactor designed to biologically convert organic pollutants (measured as COD) present in the wastewater into biogas. Installing a BIOPAQ®ICX reactor can have the following objectives:

- Reduction of VFA in water loop to make sure odour free paper production.
- Energy production from wastewater in the form of biogas.

- COD removal in order to comply with effluent standards.
- Pre-treatment before e.g. an aerobic treatment.
- Reduction of the operational costs of an existing treatment plant (e.g. aerobic treatment).

The anaerobic conversion of COD (organic compounds) into methane is a biological process, which can be divided in several process steps done by a mixed culture of micro-organisms. The process steps of anaerobic COD conversion can be summarized in two major process steps:

1. Acidification
2. Methane formation

During the acidification process large organic compounds are converted into volatile fatty acids (VFA). These are small organic molecules, mainly acetic acid. This acidification process does not significantly change the COD concentration itself, but just changes the composition of the COD. Large organic molecules are basically "broken" into smaller organic molecules, which subsequently serve as food for the methane producing micro-organisms.

The acidification process occurs partly in the pre-treatment upstream of the anaerobic reactor (e.g. sewer system, buffer/acidification tank) as well as inside the anaerobic reactor. The acidification which takes place upstream of the anaerobic reactor is called "pre-acidification". In most cases a certain degree of pre-acidification is desired, because this enhances the performance of the anaerobic reactor and the biomass quality inside the anaerobic reactor. In some industries the acidification process is less relevant (e.g. chemical industry), as the COD is already present in the form of organic acids or the specific COD compounds do not acidify in a pre-treatment.

In the reactor the anaerobic micro-organisms convert the COD present in the pre-acidified wastewater into methane (CH_4) and carbon dioxide (CO_2). The generated biogas is collected in the headspace of the reactor and subsequently transported to a gas buffer or other gas processing unit. The treated wastewater is separated from the biomass in the separators and leaves the reactor with a significant reduction in its COD concentration.

Besides the formation of biogas from COD, sulphurous compounds (sulphate, sulphite, thiosulphate and sulphur) are converted into hydrogen sulphide (HS^-) by sulphate reducing bacteria, which leads to the presence of H_2S in the biogas. This reaction is unwanted because it consumes COD, which cannot be used for methane production and the formed H_2S is toxic, corrosive and odorous; this reaction however cannot be avoided.

The performance of the reactor (anaerobic conversion of COD) can be expressed in several ways. Some examples of reactor performances are:

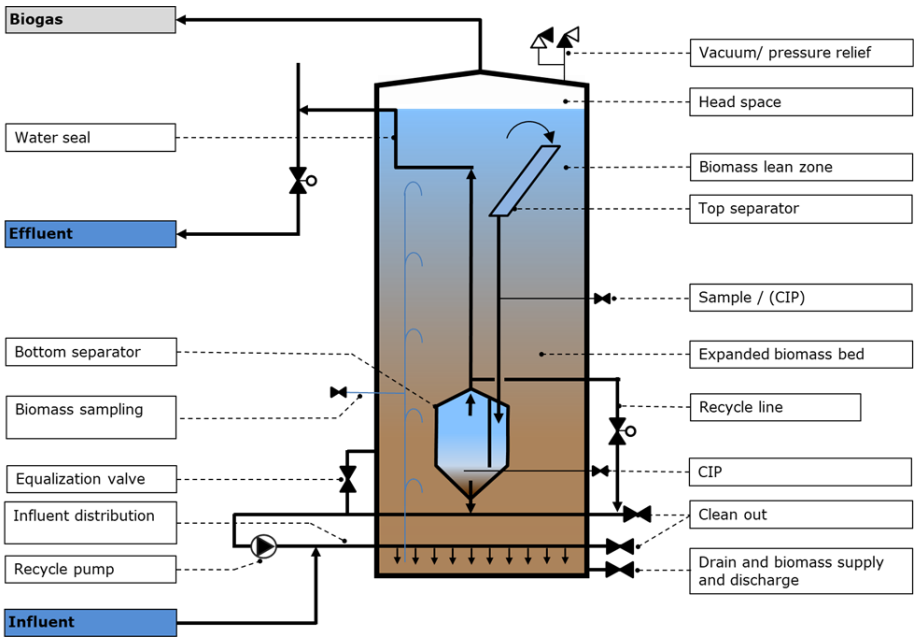
- COD removal efficiency %.
- The COD load (kg COD per day) that can be treated.
- Amount of Biogas produced per kg of COD removed.

The performance of the reactor depends on several parameters from which the most important are given below:

- The quantity and the quality of the biomass in the reactor.
- The composition of the wastewater to be treated (COD composition, presence of toxic components).
- The operation conditions of the reactor (e.g. temperature, pH, recycle flow rate etc.).
- The absence/presence of nutrients (macro and micro nutrients).
- The performance of the pre-treatment.

Schematic overview of BIOPAQ® ICX reactor:

Figure 1:



Plant operation:

Commissioning of the ETP started on 01.03.2021 with Paques BIOPAQ® ICX reactor and remarkably the plant stabilised within 2 weeks. Sunshine Paptech is producing Kraft paper as final product; Installed paper machine **capacity is 250 TPD and paper production is 250 TPD**. After implementing BIOPAQ® ICX system Sunshine Paptech is now able to produce odour free paper. Before implementation of closed loop Sunshine Paptech was facing issues of odour control. Now water loop COD, VFA is maintaining in lesser concentration hence Sunshine Paptech is producing odour free paper. Due to adequate biological treatment system Sunshine Paptech is now able to recycle 100% secondary clarifier water for their paper making process therefore, additional fresh water is not required for paper making. The fresh water addition is equal to water evaporated in evaporation section during paper making process i.e. 1 m3 of fresh water per MT of paper produced.

Odour issue:

Odour control is the major challenge in OCC mills. The odour in the paper is caused by uncontrolled Volatile Fatty Acids (VFA) and Sulphides. These two organics and inorganics creates a foul smell when they are not under control. Operating plant with closed loop with adequate anaerobic and aerobic is the solution for the said issue. This issue has been well addressed by Paques India with the supply of suitable solution to our client, Sunshine Paptech, by operating adequate anaerobic and aerobic. Due to sufficient treatment of water Sunshine Paptech is now able to produce odour free paper and discharging water is no more a necessary from mill because influent characteristics are well suited for paper making process.

Water loop SCOD and inert SCOD:

Due to closed loop operation accumulation of inert SCOD in the water loop is inevitable for certain level. SCOD which is coming out from secondary clarifier is considered as inert SCOD. The inert SCOD in water loop is not further degradable by biological system. Hence this SCOD concentration will not come down in any anaerobic and aerobic system. Inert SCOD concentration vary from 1500 to 2000 mg/l. Mainly the odour causing elements like Sulphide and VFA will be negligible

level after BIOPAQ® ICX followed by aerobic system. Hence this inert SCOD concentration does not cause any odour issue in the paper product.

The difference of mill water loop characteristics has been given in the below table:

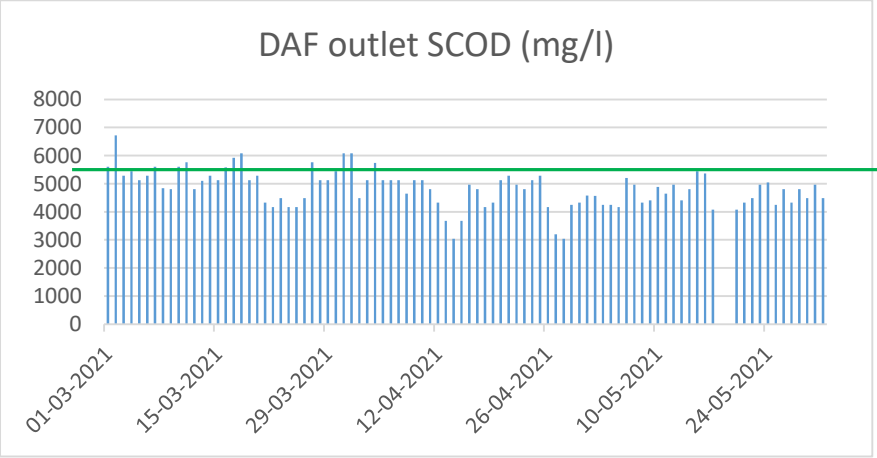
Table 1:

S. No	Parameters	Before BIOPAQ® ICX	After BIOPAQ® ICX
1	pH	6.02	6.7
2	TSS (mg/l)	465	350
3	TDS (mg/l)	22500	8000
4	Calcium (mg/l)	3046	650
5	VFA (meq/l)	463	20
6	Paper odour	Yes	No
7	SCOD (mg/l)	47400	5200
8	Biogas generation (m3/d)	0	3000 - 3500

As per above table we can understand the importance of wastewater treatment to produce odour free paper. From above table it is clear that all the major parameters are under control after implementing BIOPAQ® ICX in closed loop operation. After its commissioning VFA and SCOD in the water loop came down 10 times lesser.

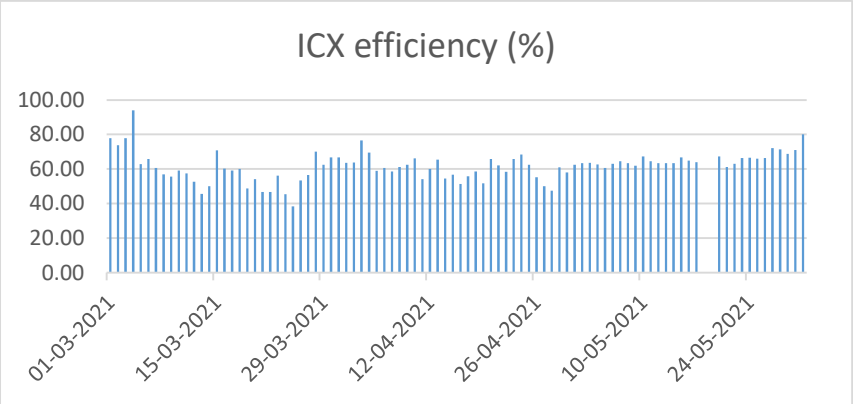
Graphical representation:

Graph 1:



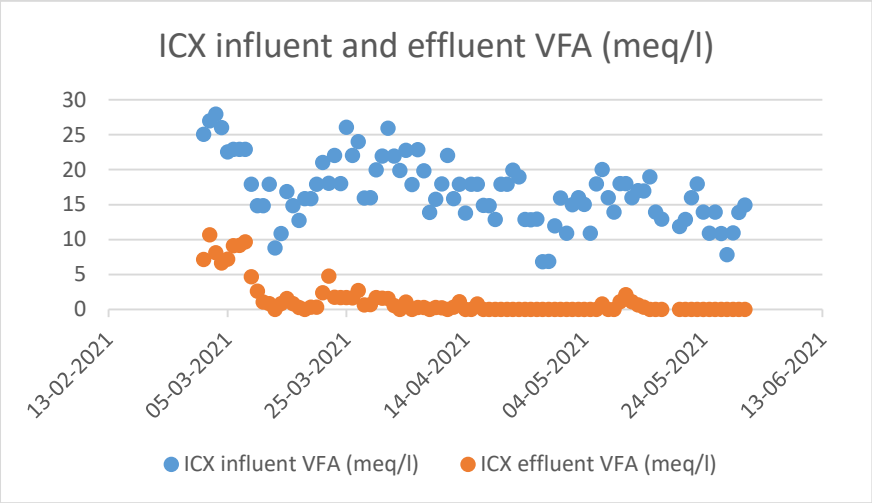
After implementing BIOPAQ® ICX and aerobic system Sunshine Paptech SCOD concentration in the water loop has come down to 5000 – 5500 mg/l which is well suited for making odour free paper.

Graph 2:



BIOPAQ® ICX efficiency has been registered between 55 – 70%.

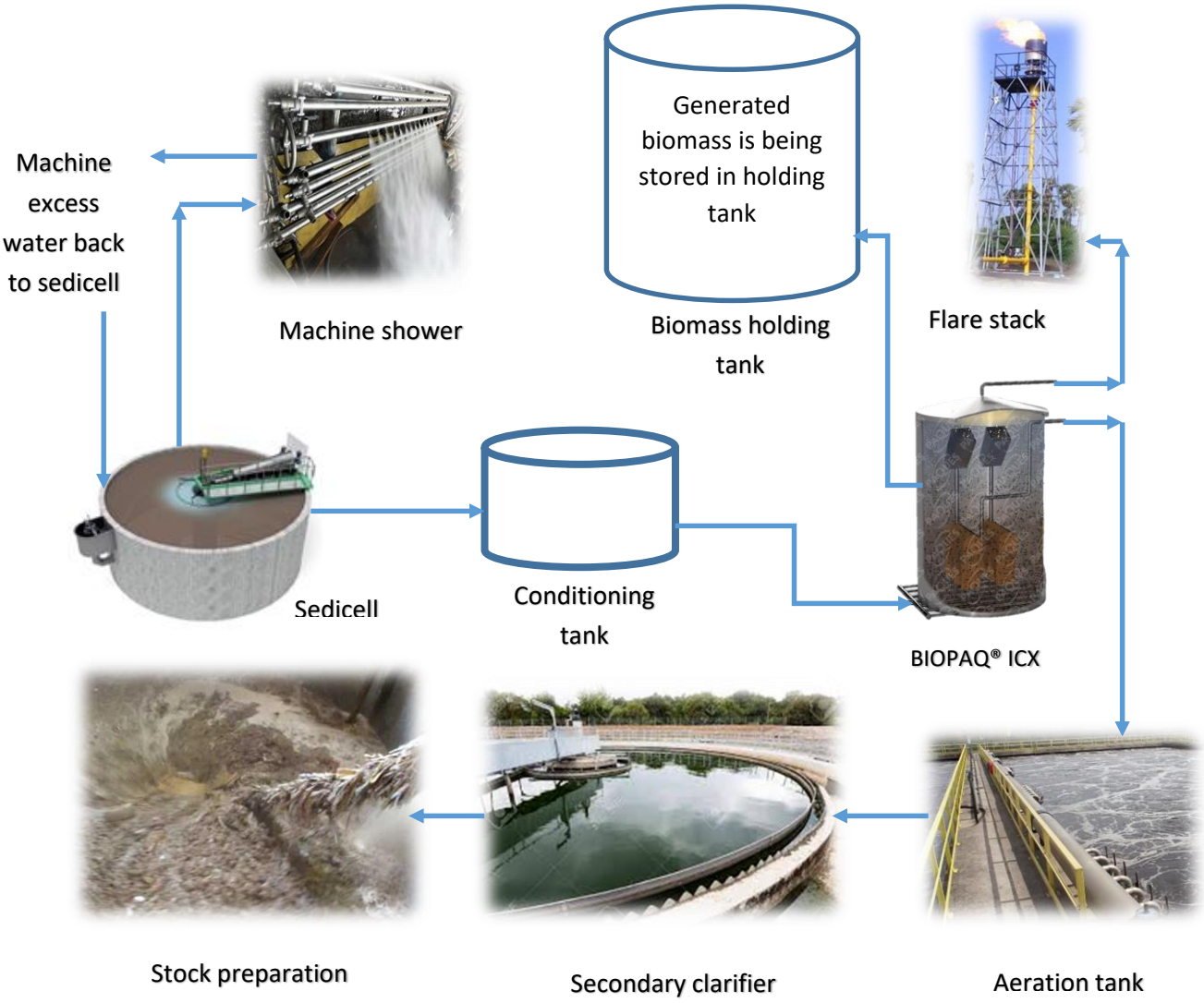
Graph 3:



BIOPAQ® ICX effluent VFA is maintaining less than 5 meq/l though the influent VFA is varying from 10 to 25 meq/l. This indicates the steady state operation of BIOPAQ® ICX though there is variation of influent.

Closed loop circuit after BIOPAQ® ICX:

Figure 2:



Benefits of closed loop system with BIOPAQ®:

1. Client is able to produce odour free paper.
2. Fresh water consumption is less. We have to add fresh water which is equal to evaporation loss.
3. Odour generating elements like VFA and Sulphide will be under control.
4. COD in the loop will be maintain consistent concentration (5000 to 5500 mg/l).
5. Water loop TDS will come down due to proper treatment.
6. Calcium in the water loop will be under control.
7. Biogas will be generated in the BIOPAQ® and it can be utilised as energy for boiler/gas engine to produce steam/power.

Conclusion:

With reference to the above table and graphs closed loop in OCC is possible ***without installing any tertiary treatment like UF, RO and evaporation***. This is evident that Paques BIOPAQ® ICX reactor can operate with closed loop in OCC mills and because of this more capital and operational expenses can be reduced. The major problem of water disposal and odour free paper production is not a matter of concern to Sunshine Paptech anymore. With the operation of BIOPAQ® ICX and adequate aerobic system we are maintaining mill water COD and VFA in the water loop which will make sure that paper production is odour free for our clients. The entire treated water from ETP can meet paper mill process requirement and it is not necessary to add more fresh water in the system. This will help our customers to optimise fresh water consumption and the plants which is located in drought area to achieve their production capacity with available water resources. In closed loop operation **fresh water consumption is 1 m3/MT of paper produced**.

Odour Testing Certificate:

The Kraft paper (end product) from Sunshine Paptech is certified as odour free & food grade with closed loop operation by renowned third party testing agency, SGS Laboratories.

SGS

TEST REPORT

Report No. : MAN:HL:1248003187 **DATE :19th May, 2021**

TEST RESULTS:

GERMAN FOOD, ARTICLES OF DAILY USE AND FEED CODE OF SEPTEMBER 1, 2005 (LFGB), SECTION 30 & 31 WITH AMENDMENTS:

SENSORY EXAMINATION – ODOUR AND TASTE TEST:

Method: With reference to DIN10955: 2004
Test condition: 40°C for 2 Hours
Test media: Bread
No. of panelist: 6

Test Result:

Test Media	Test Item	Result		Maximum Permissible Limit
		1	2	
Bread	Sensorial examination odour	0	0	2.5
	Sensorial examination taste	0	0	2.5
Conclusion		Pass	Pass	--

Tested Item: 1. 180 GSM Kraft Paper, 2. 200 GSM Kraft Paper

Note: 1. Intensity scale (rounded at 0.5):
0 – no perceptible difference
1 – just perceptible difference
2 – slight difference
3 – marked difference
4 – strong difference
2. Permissible Limit is according to German Food, Articles of Daily Use and Feed Code of September 1, 2005 (LFGB), Section 30 & 31 with Amendments.
3. Testing has been performed as per client's request