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EXPERIENCE AND RESULTS OF FIRST ANAEROBIC TREATMENT PLANT FOR PULP MILL EFFLUENT AT PUDUMJEE PULP & PAPER MILLS LIMITED, THERGAON, PUNE

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Abstract

Pudumjee Pulp and Paper Mills Ltd. have a 30 TPD bleached bagasse pulping capacity and a paper manufacturing capacity of about 60 TPD depending on grades of paper manufactured. Due to the small size of pulping operation, chemical recovery is not a vialble option and hence the total pulp mill effluent is being treated to the required standards before it is utilised on land for agriculture purpose.

Due to rapid urbanisation of village Thergaon, where the mill is located, land available for agricultural operations has drastically reduced and it is felt that these would no longer be viable in near furture. Looking at this scenario the mill has in the long term decided to eventually meet the stream discharge parameters for its treated effluents and hence as a first step decided to install Anaerobic Treatment System which would pre-treat the effluent before the activated sludge treatment which is successfully running since the year 1972.

Our Anaerobic system consists of two digesters running in parallel. This is a mixed-bed type anaerobic treatment to treat pulp mill black liquor. A number of new features are incorporated in the entire scheme with a view to maximise benefits and achieve high efficiencies in BOD/COD removal The entire plant operations including safety equipment are controlled from one control room by one operator with the help of a micro-processor based system.

Our paper describes the first experience on treatment of pulp Mill black liquor by anaerobic path and give results of operations. Within a short span after start-up, the plant has achieved substantial savings in energy and chemicals, besides BOD/COD removal efficiencies.

The pulp and paper industry in India would benefit from our experience in Anaerobic treatment which is serving the dual purpose of energy generation and effluent treatment.

Introduction

Water and environmental pollution is one of the most serious problem facing the small and medium sized Pulp and Paper Mills in our country today. The survival and growth of this sector wil ultimately depend upon how these problems are solved. The options available also seem rather restricted, they are.

1. Not to undertake any pulping activities and utilise purchased pulps thereby no secondary treatment of effluent is necessary.
2. If pulping activity is carried out then to undertake chemical recovery from the black liquor and subseuently do a light treatment of the effluent.
3. To treat the effluent in the most economically and technically feasible process.

Due to environmental problems a number of small mills have already shifted to the first option, that of manufacturing paper from purchased waste paper or pulps. As regards the second option of chemical recovery from black liquor it is expected that Pilot Plant trials will commence in 1989 at CPPRI and a viable option may be available by 1991, however, this is at the moment uncertain. In the short term therefore mills that are having a pulping operation will be required to undertake proper treatment before disposal and so far an activated sludge treatment plant is the only proven system available in the country today.

The major disadvantage of the activated sludge treatment plant is the fact that it is a high energy consuming plant and needs Careful monitoring to ensure proper operations to obtain the required results.

Anaerobic·treatment, although welknown as a mode of waste water treatment in various industries is not yet well established in most parts of the world in the pulp and paper industry. This is mainly due to the fact that the pulp and paper industry in the West are of a large capacity and all of them have very high efficient chemical recovery units. Therefore the need for anaerobic type of treatment is not very existant. Our initial research showed that there were a handful of Anaerobic plants planned in the early eighties mainly in Europe for TMP and CTMP pulping operations and our analysis also showed that effluent characteristics were fairly similar to the effluent emanating from our mills. Thereafter we undertook extensive laboratory work to look at the feasibility of this process and the results confirmed the possibilities of success.

Amongst various types of reactors available for anaerobic treatment we preferred the mixed bed type reactor as best suited to the Indian conditions where power trippings are frequent as also the variations of process parameters from any small pulping operations. The mixed bed reactor is slightly more capital intensive than other type of reactors but we feel that it would be more suitable to power outage as also variables in the flow of effluent coming to it. This stability would ensure a better return by way of stable gas generation.

It was also found that biomas activity is substantially altered if there is mechanical shearing when pumped. Reactor design was therefore so selected that all clarifiers are located at the dome level of the digester and biomass goes back into the system by gravity from the top. We have also spent a large amount of money on instrumentation of the system so as to be able to ensure proper functioning of the digesters as also to extract the maximum possible gas out of the system. The instrumentation serves the dual purpose of ensuring safety of the process and gas handling.

Description of Anaerobic Treatment Plant

The treatment plant is shown schematically in Figure-1. The Two digesters are fabricated out of mild steel plates, each with a volumetric capacity of 6200 M^3. The domes are fixed type and made of mild steel with gas holding capacity of 400M^3 in each digester. The solid-gas and solid-liquid separation is done by syphon agitators (degassing ponds) and lamella clarifiers respectively which are located in the top annular space. The two lateral agitators are provided on each digester for mixing of the biomass with raw effluent entering at the bottom through the central column. Both the digesters are fed in parallel. Other parameters are :

—	Flow m^3/hr	200 ± 50
—	Suspended solids mg/l	400 Avg. 500 Max.
—	Soluble BOD5 20°C mg/l	1800 Avg. 2500 Max.
—	Soluble COD mg/l	5500 Avg. 7000 Max.
—	Temperature of the reactor contents °C	35-37

The plant is operated by one operator from the control desk with microprocessor based auto-controls. The process parameters like pH, Temperature, Volumetric loading, organic suspended solids, volatile acid concentration and alkalinity are properly controlled to maximise biogas generation and BOD/COD removal.

The safety measures include auto-flare-off system, flame traps at required locations on the biogas pipeline, quick shut-off valves at burner side, over-under pressure release system on the digester dome, micro-processor based dual burner system in the boiler house, etc.

The pulp Mill Effluent is pretreated to remove the suspended matter in the clarifier. The clarified affluent enters the buffer tank provided to accomodate flow variations. A uniform feed volume is maintained to both the digesters since they are operating in parallel. The planned details of each digester and process data are :

- Volume	6200 m^3
Flow to each digester	100 $\pm$ 25 m^3/h
- Retention time	50 hr.
- BOD removal	90%
- COD removal	705
- Specific gas - production	0.45-0.5 m^3/kg COD destroyed.
- Calorific value of - biogas - (75% methane+25% CO2)	5400 Kcal/m^3
- pH range	6.8-7.6
- Temperature range	35-37^{0}C
- Organic suspended solids	8-10 gr/lit.

The raw effluent parameters are :

- pH	9-9.5
- Temperature	36^{0}C.
- BOD5 20^{0}C.	2500-2800 mg/l
- COD	8000-10000 mg/l
- Volume	2500-3000 m^3/d

We are feeding mainly the black liquor from brown stock sections till the biomass is fully adapted and desirable level of active biomass is attained in both the digesters.

The treated effluent anticipated from anaerobic digesters would have the following characteristics :

- pH	7.4-7.6
- Temperature	36-37°C.
- BOD5 20°C.	200-250 mg/l
- COD	2000-2100 mg/l
- Suspended matter	100-130 mg/l

The effluent is further treated in the mechanically aerated basin and then discharged through a polishing tank and distribution chamber for agricultural use.

Start-up and Operation

Both the digesters were seeded with fresh cow-dung slurry and activated sludge. A small volume of digested municipal sludge was also introduced. The raw effluent was fed in stages so as to adapt the anaerobic bacteria to organic waste and build-up the active biomass. Nutrient chemicals were also added in suitable proportions. Since the raw effluent temperature was always above 35°C, very little heat energy was consumed during seeding operations. Some of our observations since start up are noted below :

-- Biogas generation started within ten days of completion of seeding operations and went on increasing with increase in volume of the raw effluent.

-- Gas generation level reached 4000 m^3 on the thirtieth day.

-- BOD and COD reduction levels reached 70% and 50% respectively within 50 days and have reached 80% and 60% within six months of start-up.

-- The digester could tolerate wide fluctuations in effluent flow.

-- Specific gas production reached 0.45–0.5 m^3/kg.

-- COD destroyed in six weeks from start-up.

-- The active biomass concentration reached 7 gr/lit and build-up is according to expected levels.

-- All the instrumentation for process control and safety systems are operating satisfactorily.

-- Methane and Carbon dioxide content in the biogas are 75% and 25% respectively and were found stable.

The above observations are graphically presented in Fiq. 2 and 3.

Experience after Operation

We have achieved continuous increase in BOD/COD reduction efficiencies as seen from Figures 2 and 3. They are slightly above 80% and 60% respectively. The active bioimass has built-up to 7 gr/lit.

The specific gas production is ranging between 0.45–0.5 m^3/kg COD destroyed. The gas consumed in the boiler has now reached 6500 m^3/d. The energy from biogas has helped us to reduce LSHS oil consumption by 3 tonnes everyday. This reduction in oil amounts to about 15% of the daily consumption and valued at Rs. 10,000/ day.

We have been able to shut our old diffused aeration plant for activated sludge treatment and only the mechanical system is operating. This has resulted in power savings to the tune of 4,000 Kwh/d. This has also resulted in reduction in nutrient chemical requirement by 30% or 5 tonnes every month. Thus net saving in power and chemicals correspond to Rs. 1.5 lakhs every month.

Other importent observations in the anaerobic treatment are :

-- Reduction in colour concentration by about 25%.

-- Reduction in foaming as indicated by reduced defoamer consumption by 30% in post-anaerobic treatment.

The economic assessment of the anaerobic process is based on benefits gained by us today and corresponding projections could be made. But it is certain that more benefits would accrue in the future from this system which would not at all come from aerobic treatment.

Solid Waste Disposal

The total quantity of solid waste is 15 tonnes on ovendry basis. This consists of bagasse dust, pith, uncooked fibres, silica and fibert + filler from the paper making sections. The excess secondary sludge is also wasted. All this solid waste is collected in a sludge tank nad continuously fed to the double-wire press for compaction to 30% dryness. This sludge which is in the form of a thick mat falls directly into the waiting truck for disposal. This is either used as landfill or used for burning by local people. We have started looking for better alternate uses like in board making or conversion to organic manure. This would then be additional economic benefit.

Conclusion

Pudumjee Mills are now in a position to offer anaerobic process with further aerobic treatment for pulp and paper mill effluent on turn-key basis to mills in our country.

We are quite sure that our anaerobic treatment system has a large potential that could be utilised to serve dual purpose of energy generation and effluent treatment. Both are need of the hour for not only healthy growth but the very existance of the industry in India.

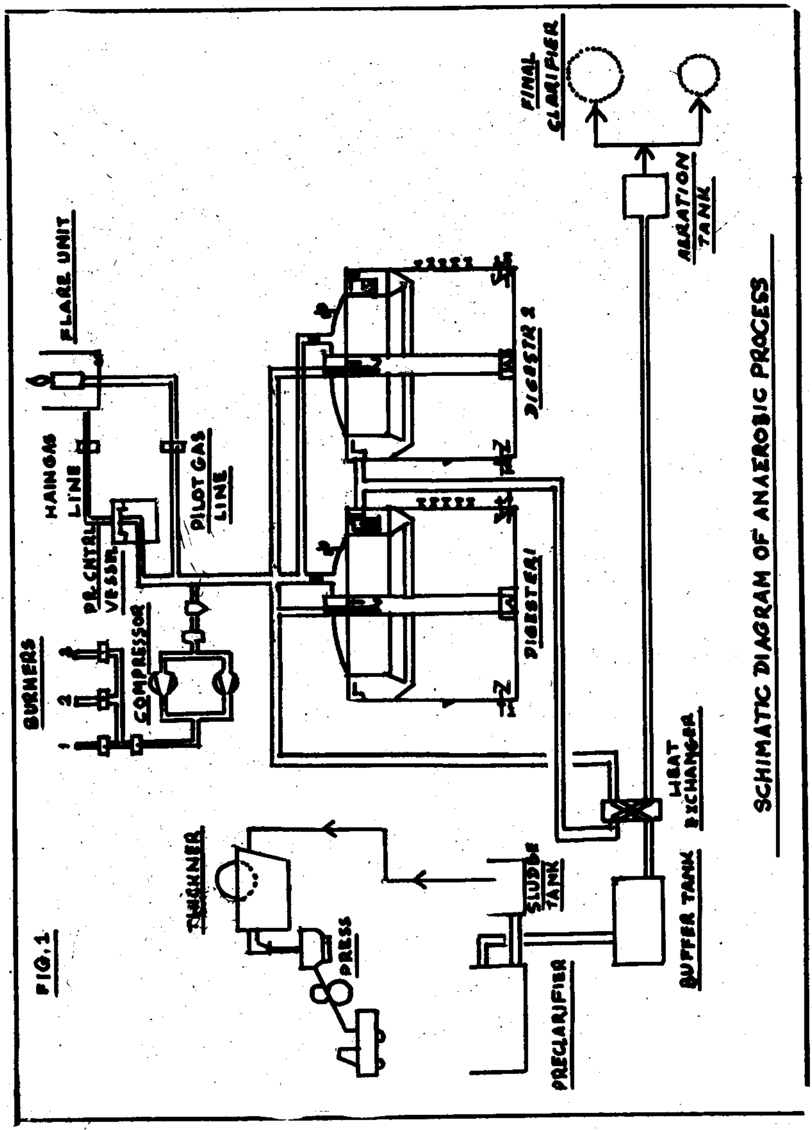

FIG.1

SCHIMATIC DIAGRAM OF ANAEROBIC PROCESS

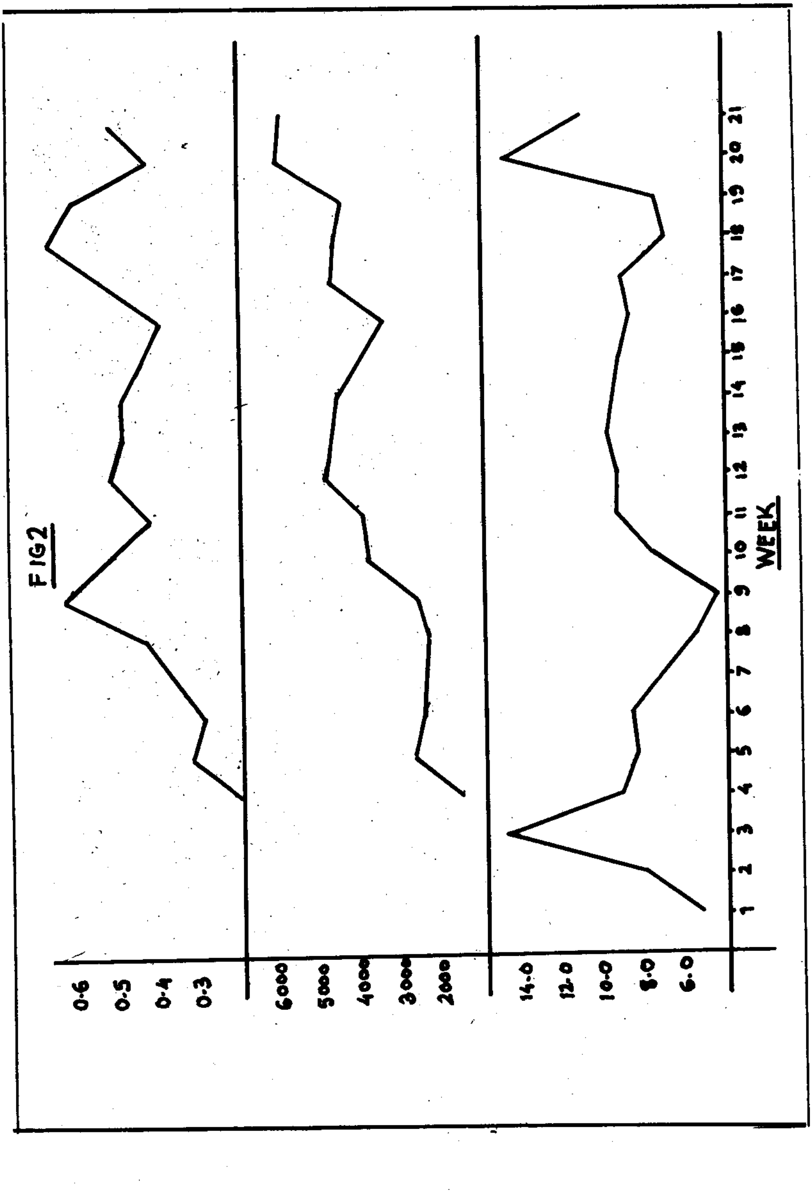
0·6
0·5
0·4
0·3
6000
5000
4000
3000
2000
14·0
12·0
10·0
8·0
6·0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
WEEK

FIG 2

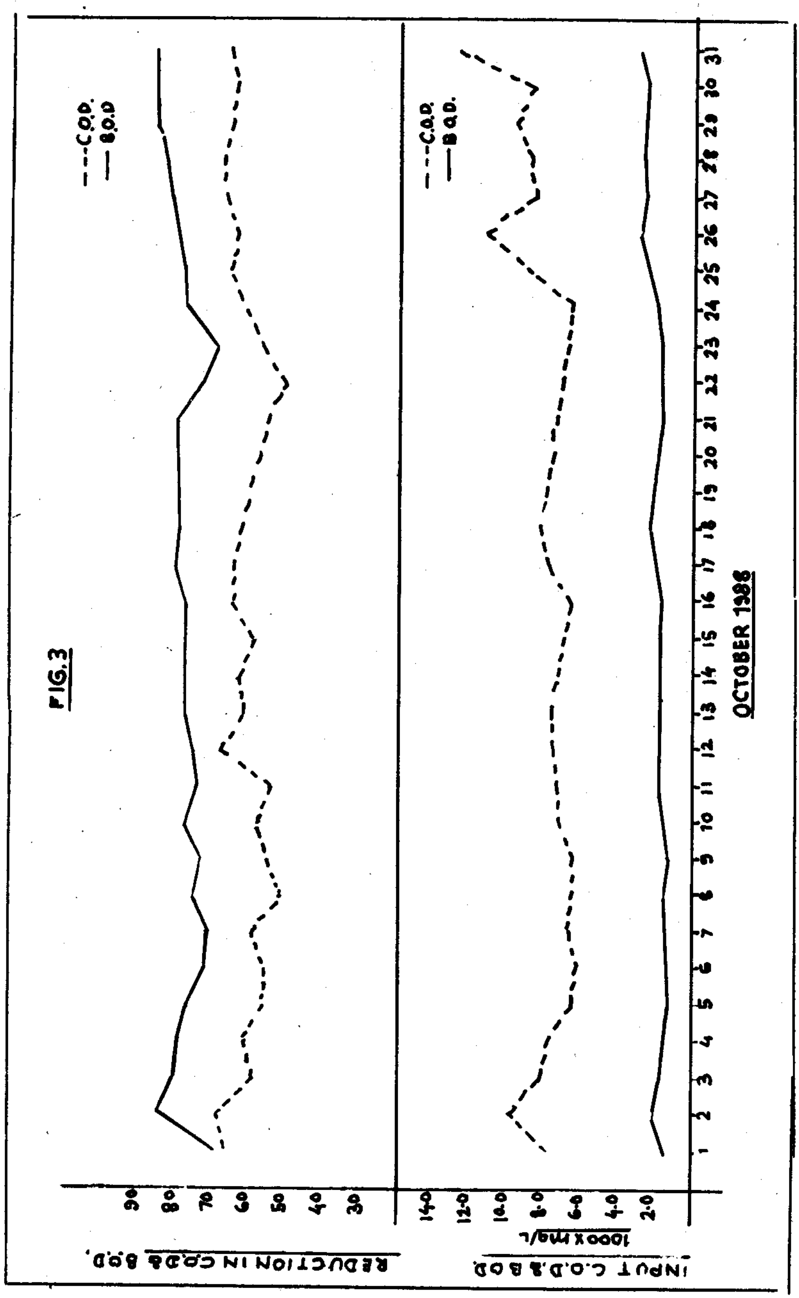

FIG.3