

# Treatment of Effluent In Smaller And Medium Capacity Pulp Mill (20-30) MTPD Agro Pulping (A Case study in Pravara Pulp and Paper Mill)

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## INTRODUCTION

In India Paper Industry uses a variety of Raw Materials such as wood, bamboo, agricultural residue and waste paper. The availability of forest based raw material is limited while the availability of agro residue is surplus but neglected.

There are so many technologies in large sectors for pulping, soda recovery, bleaching, etc. which can satisfy the pollution control parameters laid down by the Government authorities.

But, till today, there is no suitable technology to handle black liquor coming out the medium size pulp mills numbering about 70-80. Day by day Government Pollution Control Departments are putting in stringent parameters for the effluents discharged by these mills.

Government is insisting that, either these mills should go in for increasing their capacity to 100 MTPD pulping with Soda recovery system or changeover to 100% recycled fibre raw material. But, both the options are out of the reach for these mills.

- (a) There is no fund available with them to increase their capacity from 30 MTPD to 100 MTPD with installation of soda recovery. Total involvement in implementing this expansion alongwith balancing in paper making section and finishing house will be above fifteen crores.
- (b) Everybody is aware that, the 30 MTPD mills are struggling to arrange even 10 MTPD waste paper from indigenous sources. Therefore, with today's availability of indigenous waste Paper and fluc-

tuating price of imported waste paper, nobody can take the risk of depending on 100% waste paper, for which also they will have to invest sizable amount to strengthen the waste paper street.

Therefore, mills in this sector are at a loss as to what to do in the present critical situation.

Further, so far as excise duty is concerned, Government is treating the agro residue raw material at par with waste paper.

Government authorities insist on pollution free discharge which is also a social obligation for the Industry, but nobody has a foolproof answer for the solution. This is the case with almost all the industries.

Keeping in mind the problems of black liquor handling of these small/medium sector agrobased paper mills, we in Pravara pulp & paper have conceived and implemented a black liquor treatment system which may be interesting and informative to other similar paper mills.

## OBJECTIVES

As soda recovery system is techno-economically unviable in this sector, we decided to handle the black liquor in the following system.

- (a) To separate the black liquor at concentrated stage as far as possible to reduce the volume.

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**Pravara Pulp and Paper Mill**  
**P.O. Pravaranagar - 413712**  
**Dist. Ahmednagar (M.S.)**

- (b) Residual black liquor carried over is washed in following 2 Nos BSW's by counter current system in a closed circuit. Weak black liquor from BSW filtrate is partially used for dilution in the potchers.
- (c) Treating the black liquor in Anaerobic digester for Biomethanation to produce gas and reduce the BOD & COD Level.
- (d) Further, treatment of this effluent with paper mill back water effluent in existing E.T.P. System & discharge for farming.

Principles and process details are explained below alongwith flow sheet.

**PROCESS DETAILS**

Black liquor is a complex solution of various organic and inorganic compound. It is responsible for 70 to 80% of total pollution load of pulp and paper mill effluent.

Pravara Pulp and Paper Mill has capacity of 30 TPD to produce unbleached Kraft Paper with following raw materials.

(1)	Bagasse	..	70%
(2)	Waste Gunny	..	10%
(3)	Imported/Indigenous Waste Paper	..	20%

The bagasse pulp production is 20-22 MT/day. There are five nos of rotary digesters having capacity of 30m<sup>3</sup> each. The bagasse pulp from the spherical digesters is discharged in the potchers constructed below the digesters. In the potchers, the pulp is diluted to 5 to 6% consistency with weak black liquor from brown stock washer filtrate. It is forwarded to transfer chest. The slurry of pulp from transfer chest is fed to two nos. of screw presses for separation of black liquor at an inlet consistency of 5-6%.

In screw presses, most of the black liquor from the pulp is squeezed out. The separated black liquor is forwarded to screen and then stored in the storage tank. The outlet consistency of pulp after separation of black liquor by screw press is about 20%. It is further diluted and then pumped to BSW through sand trap for further processing.

Black liquor quantity processed through screw presses is 400m<sup>3</sup>/day and out of this quantity, about

100m<sup>3</sup>/day is used for make up volume in the digesters and 300m<sup>3</sup>/day of black liquor thus separated is further mixed with BSW filtrate to volume of 500 m<sup>3</sup>/day and is sent for Biogas generation purpose alongwith chemical plant effluent.

**SCREW PRESS PERFORMANCE**

(1) Inlet Consistency	..	5%
(2) Outlet Consistency	..	20%
(3) Throughput	..	20-22 MTPD (15 TPD Cap. each)
(4) Black liquor separated	..	300 m <sup>3</sup> /day.

**CHARACTERISTICS OF BLACK LIQUOR (BEFORE TREATMENT IN BIOGAS PLANT)**

(1) Quantity	..	500 m <sup>3</sup> /day,
(2) pH	..	7.0 to 7.5
(3) C.O.D.	..	20000 to 250000 Mg/Ltr.
(4) B.O.D.	..	5000 to 6000 Mg/Ltr.
(5) Suspended Solids	..	600 to 800 Mg/Ltr.
(6) Sodium	..	2800 to 3000 Mg/Ltr.

**CHARACTERISTICS OF CHEMICAL PLANT EFFLUENT (BEFORE TREATMENT IN BIO GAS PLANT)**

(1) Quantity	..	100 m <sup>3</sup> /day,
(2) pH	..	3.0 to 3.5
(3) C.O.D.	..	10000 Mg/Ltr.
(4) B.O.D.	..	5000 Mg/Ltr.
(5) S.Solids	..	Nil

**CHARACTERISTICS OF COMBINED EFFLUENT (BLACK LIQUOR + CHEMICAL PLANT) BEFORE TREATMENT IN BIOGAS PLANT).**

(1) Quantity	..	600 m <sup>3</sup> /day,
(2) pH	..	6.5 to 7.0

- (3) C.O.D. .. 20500 to 21000 Mg/Ltr.
- (4) B.O.D. .. 5500 Mg/Ltr.
- (5) S.Solids .. 600 Mg/Ltr.
- (6) Sodium .. 2500 Mg/Ltr.

### BIOGAS PLANT DETAILS

- Technology .. Sulzar an-Opur Process,
- Type of Digester .. Continuous stirred type reactor with external sludge settling and recycling arrangement.
- Name of Supplier .. M/s. Western Bio-Systems Ltd., Pune.
- Capacity .. 6300 m<sup>3</sup> liquid holding capacity,
- Retention time .. 10.5 days,
- C.O.D. Loading Rate .. 2.0 to 2.5 Kg/m<sup>3</sup>
- C.O.D. reduction .. 60 to 65%
- B.O.D. reduction .. 85 to 90%
- Biogas Production .. 0.53 NM<sup>3</sup>/Kg COD destroyed.
- Methane Content .. 60 to 65%

(Note-flow Chart No. 1 enclosed).

### PROCESS IN BRIEF

The black liquor is stored in an equalisation tank to take care of shock loads and raw material changes. Suspended and floating solids are removed and the clear effluent having uniform characteristics is fed to biogas reactor. A uniform flow of liquor through the reactor is adjusted by the help of flowmeter. Agitators fixed at various points to the biogas reactor continuously mix the reactor contents.

In the biogas reactor the effluent is treated with the help of anaerobic bacteria which converts organic pollution load to methane and carbon dioxide.

The outflow from the biogas reactor is sent to Degassifier to remove gases. Degassed fluid then flows to lamella clarifier to settle bacterial sludge. The clear liquor from the clarifier is the treated effluent after biogas plant.

The sludge settled in the clarifier is recycled back to the biogas reactor. The gas generated is collected in the gas holder by pipe line from the reactor.

### MONITORING OF THE DIGESTER

The operation of digester is supervised by operators in each shift with the help of supporting staff. (Two in each shift). The pH of the digester is measured six times in a day. COD of inlet and outlet effluent is analysed once in day. The concentration of volatile acid in the reactor is also analysed in each shift.

Biogas generated is collected in separate gas holder. We have been able to achieve the gas generation upto 3000 Nm<sup>3</sup>/day. The collected gas from the gas holder is then passed to boiler along with the biogas generated from distillery effluent from separate plant.

Characteristics of the effluent after Biogas generation plant.

pH	..	7.5 to 7.8
COD	..	8000 to 9000 Mg/Ltr.
BOD	..	800 to 850 Mg/Ltr.
Sodium	..	1200 to 1350 Mg/Ltr.

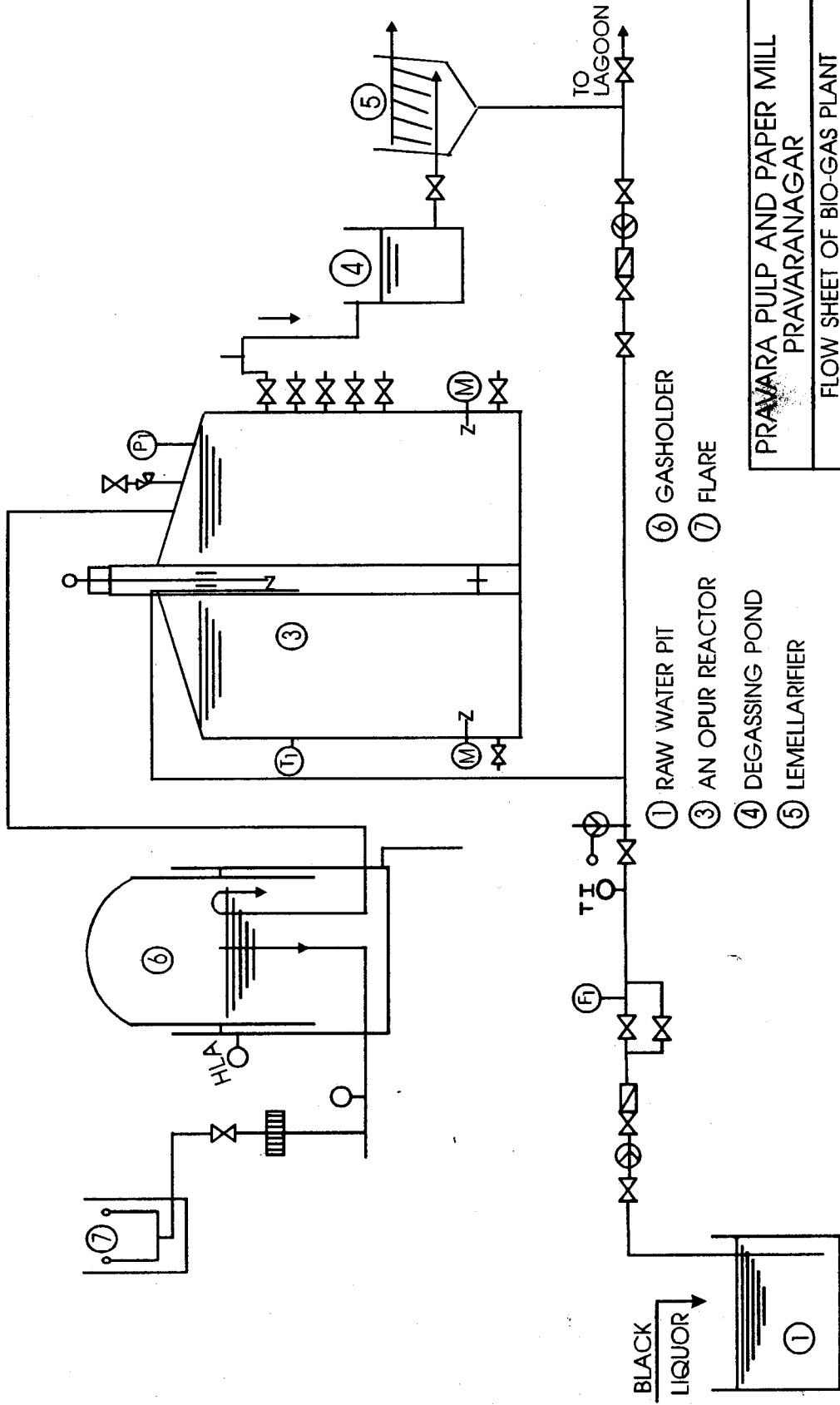
### PROBLEM FOR SCREW PRESSES

It is very difficult to arrest the winding wire chips before feeding to the screw presses which is very sensitive. However, after trial & error for two months, we have been successful to get rid of the foreign material by arranging horizontal/vertical traps, magnets etc.

### PROBLEMS FOR ANAEROBIC DIGESTION

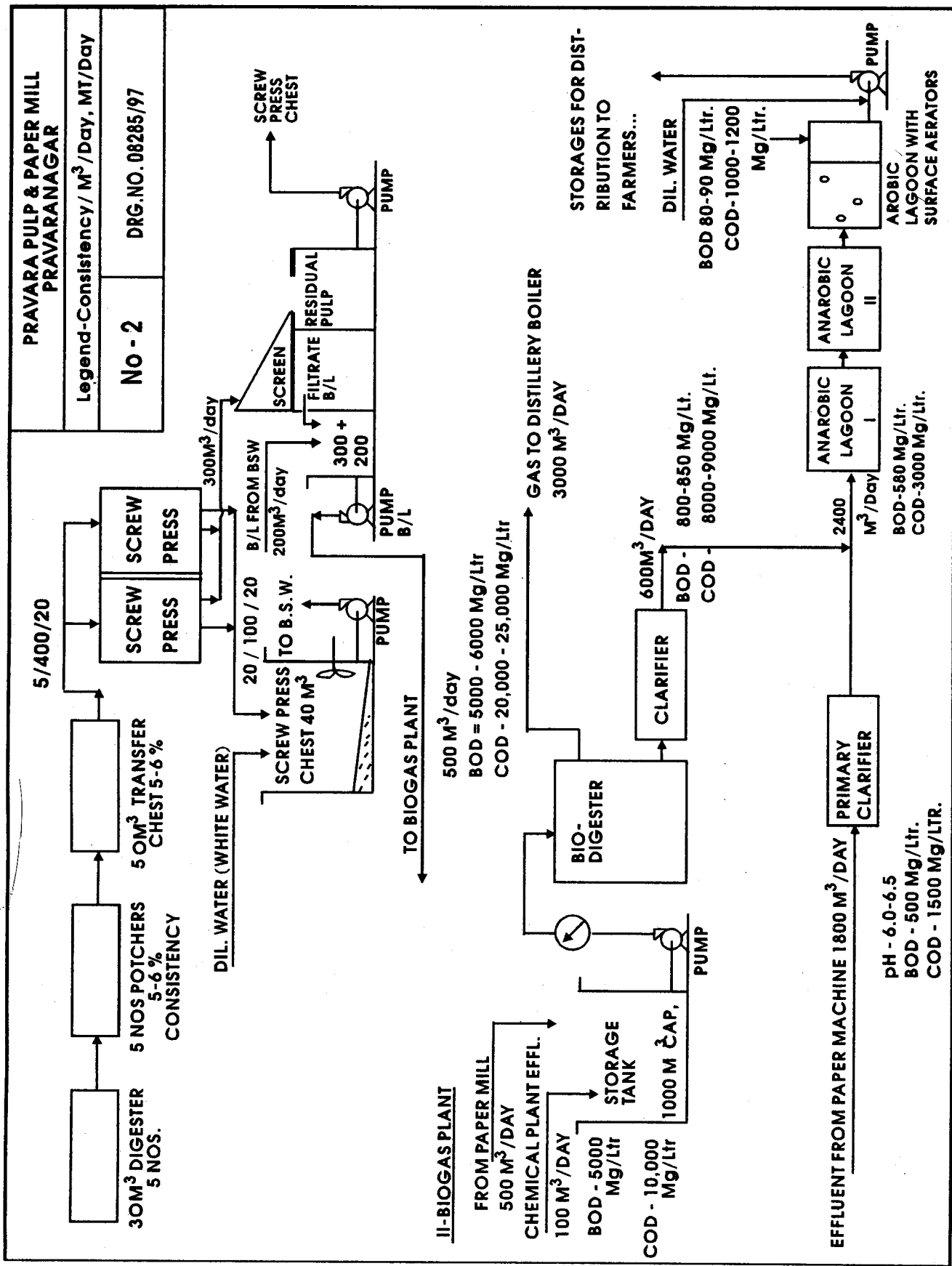
- (1) The temperature of the black liquor at the biogas plant is very low (25°C to 30°C) whereas our digester works in the temperature between 32°C to 38°C for this purpose some times we have to raise the temperature of black liquor with PHE using hot spent wash.
- (2) Volatile acids in the black liquor and chemical plant effluent are varying in the range of 1200 PPM to 2500 PPM. Due to this, buffering capacity in the digester is affected.
- (3) The overflow from the digester to the degassing pond creates lot of foamings, making the site

FLOW SHEET OF BIO-GAS PLANT



- ① RAW WATER PIT
- ② GASHOLDER
- ③ AN OPUR REACTOR
- ④ DEGASSING POND
- ⑤ LEMELLARIFIER
- ⑥ GASHOLDER
- ⑦ FLARE

PRAVARA PULP AND PAPER MILL PRAVARANAGAR			
FLOW SHEET OF BIO-GAS PLANT			
DRAWN BY B AS		No-1	
CHECKED BY			
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shabby. The use of defoaming agent is required. However, as the consumption is higher, some other type of defoamer is required to be used.

- (4) The stabilization of the reactor is taking more time due to frequent stoppages in the paper mill.
- (5) Black liquor from paper mill is coming by pipe line to the biogas plant from about 1000 Mtrs. & then stored in the equalization tank where effluent from chemical plant is mixed. Whenever it is mixed, some times Precipitation of ligno-cellulose compound in the equalization tank, is observed. Due to this, scum formation is observed in the said tank. pH in the equalization tank in the range of 6.0 to 7.0 leads to further increase in volatile acids by activity of the acid forming bacterias.

The anaerobically treated black liquor from biogas plant is further treated alongwith paper machine effluent in two nos of anaerobic lagoon followed by one aerobic lagoon as per enclosed flow sheet No.2.

Characteristic of paper machine effluent.

pH	..	6.0 to 6.5
BOD	..	500 Mg/Ltr.
COD	..	1500 Mg/Ltr.
S.Solids	..	700 to 800 Mg/Ltr.

The Paper machine effluent is pre-treated in the primary clarifier before mixing with treated black liquor coming from Anaerobic digester.

Total detention period of anaerobic and aerobic lagooning system is of 16 days.

Aerated lagoon is equipped with three nos of surface aerators. With the help of aeration process,

the maximum pollution load is reduced.

As far as BOD is concerned, the characteristics of treated effluent will meet the standards fixed by M.P.C. Board. The treated effluent is further diluted with fresh water and then disposed for irrigation purpose. About 500 Hect. of land is used for disposal of treated effluent.

### RESULTS ACHIEVED

Trial run has been successfully completed, though the trial has been disturbed by frequent shut down of our mill for various reasons and we expect to stabilize the process within one to two months.

- (1) We have reduced water consumption by about 30%.
- (2) Pulp quality has been improved due to pith separation in the screw press which results increase in strenght properties of paper.
- (3) The pollution load is reduced to the maximum.

### CONCLUSION

Black liquor is responsible for 70 to 80% pollution load of pulp and paper mill effluent. It should be separately treated to reduce the total pollution load.

For effective separation of the black liquor, the screw press system is very useful, which results in saving in the water quantity upto 30%.

The biogas generation from the black liquor is possible & we have been able to generate about 3000 Nm<sup>3</sup>/day of biogas from the effluent of 20 MTPD pulp mill.

The process is under stabilization and the biogas generation could be improved to about 5000 Nm<sup>3</sup>/day (appr.).