3 Operating Instructions

This section describes inspection and other work (including cleaning) that normally is carried out by the operator. Mechanical maintenance including disassembly for internal inspection and repair of the main parts is described in Section 4.

3.1 Safety

The Kværner Screw Press is designed as a totally enclosed structure. The operation of the screw press does not require personal attendance by the operator. Normal mill-wide safety practice will therefore generally be adequate. However, the following notes should be considered.

For periodic inspection of the dewatering process, lids (windows) are provided in the cover and there is a lid on the top of the outlet house. If the pulp has a high temperature or if the liquid has other properties detrimental to the health of the operators or to clothing, such inspection should be carried out using protective glasses and/or protective clothing. Always keep the lids closed during normal operation.

As for piping and other process equipment, the temperature of the outer surfaces of the screw press will be similar to the temperature of the pulp. Access restrictions or external guard arrangements should be considered in extreme cases.

Routine sampling should always be made from properly protected sampling points, not from the lids that are provided on the outlet house for maintenance access.

For mechanical inspection and maintenance work, the drive unit should be disabled and normal safety rules for maintenance in industrial environments should be followed.

3.2 Starting

In the following it is assumed that the press has been started up according to the procedure given in Section 2, and that the shutdown has been of a short duration (a few days).

Before starting the press, check the following:

1. The bearings of the screw press should be lubricated with oil and grease. Check the oil level sight glass carefully. Lubrication of additional equipment such as gear drive and couplings should also be checked.

2. The seal water should be turned on and flowing.

3. Air pressure for the counterpressure system should be connected. Check for air leaks. Reduce the pressure to zero before starting the press.

Start the press and let it run for about five minutes without pulp. The seal water at the inlet end should be flowing also during this period to avoid damage to the seals. Check for unusual noises (touching between the press screw flights and the screens). Check that the bearings are working properly.

If everything runs normally, open the pulp valve ahead of the press and allow some time for the formation of a normal "plug" in the outlet section. Increase the pulp flow gradually and when full capacity and stable conditions have been reached adjust the pneumatic control of the counterpressure system to obtain the required stock consistency. Ten to fifteen minutes may be required to obtain stable conditions.

Note that the counterpressure cone is adjustable, and that it has to be positioned correctly for optimal results (outlet consistency).

Open the plug/cover on the side of the frame under the outlet house briefly and check that the water from the screw stem screen is flowing freely.

3.3 Stopping

Before stopping the press, turn off the counterpressure and shut off the pulp flow (feed pump). Then the press should be allowed to run for 5 to 10 minutes to allow it to empty as much as possible. After this period the press can be stopped.

A pulp plug will normally remain in the discharge nozzle between the end of the press screw flights and the counterpressure flaps. For a short shutdown period (a few days), it is not necessary to remove the plug.

For a longer shutdown period, the outlet housing should be hosed with water to flush out the plug. The screen systems should be flushed internally by adding water from a flushing valve and/or by feeding water instead of pulp from the pump system. The external surfaces of the screens are best cleaned with a high-pressure spray unit.

3.4 Normal Operation

The Kværner Screw Press does not normally require attention or adjustment during operation since it will allow for some variations in inlet pressure (pulp flow rate) and consistency without affecting the overall capacity and the outlet consistency significantly.

3.5 Operator Maintenance

To ensure trouble free and stable operation, certain periodic inspection and maintenance tasks are recommended on the part of the operator as listed in the following table.

Table 2 - Routine Inspection by the Operator

Object	Task	Frequency
Dewatering function	Check for normal function	Once per day
Screen system	Flush from the outside	Once per month
Screw stem screen	Check for normal function	Once per month
Seal water flow	Check for actual flow	Once per month
Counterpressure	Check for normal function	Once per month
Wear of screw flights	Check (calculate) spec. power demand	Twice per year

In the following, these tasks are discussed in detail.

Dewatering Function
Inspect the discharge of dewatered pulp by opening the lid on top of the outlet house. Check for apparent consistency and flow pattern.

Screen System
Inspect the cylindrical screens through the cover windows. The screen surfaces should not be allowed to accumulate large amounts of solids and the flow of water through the screen holes should not be obstructed by incrustation. Flush as needed.

Screw Stem Screen
Open the plugs/covers in the base frame under the outlet house and inspect the flow of water from the screw stem screen. If water is not flowing at this point, the channels should be flushed. Access is obtained through the lid on the top of the outlet house and through the covers in the base frame.

There are also flushing nozzles on each side of the outlet house as well as in the base frame. These can be connected to hoses/pipes for regular flushing of the channels from the screw stem screen in the outlet house and in the base frame. If flushing at these points is not successful, the problem may be in the stem screen and/or in the channels under them or in the hollow screw stem. In this case, the screw press must be stopped and one of the shredders on the press screw stem in the outlet house must be removed. A hole under these shredders provide for access for high pressure water spraying.

Seal Water Flow
The flow of water to the lantern seal of the inlet bearing assembly should be checked by inspecting the flow meter/indicator. The flow rate should be more than 0.5 l/min but not above 10 l/min. A typical value is 3 l/min. If the seal water contains fibre or particular impurities, more frequent checking may be required.

Counterpressure System
The counterpressure system should be checked for air leakage which may cause improper operation of the flaps. Points to look for are the seals of the pistons and the connectors of the pneumatic tubing.

If a leak has been detected, and as a temporary action until proper repair can be done, the counterpressure cone on the shaft can be moved slightly (5 mm) towards the inlet end. This requires only a very short stop (15 min) and will normally give acceptable outlet consistency until the press can be stopped for a longer period of time. Then, the counterpressure system can be given a thorough mechanical examination and the seals replaced as required.

Screw Flight Wear
The edge of the final flights (wings) of the press screw are prone to wear, resulting in a rounded leading edge and in severe cases the diameter may be reduced. The rate of wear is related to impurities that may be present in the pulp (e.g. sand, grit, etc.), and to the operating conditions (high outlet consistency). Excessive wear may cause high power demand and plugging of the screen holes. In extreme cases, the drive may overload since more power is used to overcome friction and less is available for dewatering purposes.

An early sign of excessive wear is increased amperage and/or poor dewatering performance. If such a situation is detected, the final flight section must checked by a mechanic. The procedure for this is given in Section 4.4.

To give the operator information on the wear situation in advance, the specific power demand (kWh/ton) may be calculated periodically as indicated in Table 2. For hydraulic drives, the power uptake may be calculated from the hydraulic working pressure, the charge pressure and the speed. For mechanical (gear) drives, the calculation ideally should include consideration of the phase angle and efficiency of the electric motor at the actual operating point as well as the efficiency of the gear belt drive unit. Note that comparison of specific power data requires similar operating conditions, in particular regarding pulp type, outlet consistency and temperature.

3.6 Adjustment of the Screw Press

If the variations in inlet pressure (flow rate) and consistency are large, or if the press is operating in the upper or lower end of the capacity range, it may be necessary to adjust the operating parameters.

The most important of the parameters that can affect the performance of the Kværner Screw Press are noted in the following table.

Table 3 - Operating Parameters

Parameter that is changed (increased):	Effect on the screw press performance -	
	Capacity	Outlet consistency
BASIC PARAMETERS		
Speed	Increase	Decrease
Counterpressure	Slight decrease	Increase
PROCESS PARAMETERS		
Inlet pressure	Increase	Slight increase
Inlet consistency	Increase	Slight increase
Temperature	Slight increase	Increase
PULP QUALITY		
Freeness (CSF)	Increase	Slight increase
Fibre fines fraction	Decrease	Slight decrease
Ash/filler fraction	Decrease	Slight decrease
pH-value(above 9,5)	Slight decrease	Decrease

The response indicated in this table is generalized and simplified. For some of the parameters, the response reaches a maximum (or minimum) value and can afterwards vary in the opposite direction. It should also be noted that several of the parameters listed above are not independent, i.e. they may have secondary effects on each other. Thus, the overall process model is more complex than indicated by this table.

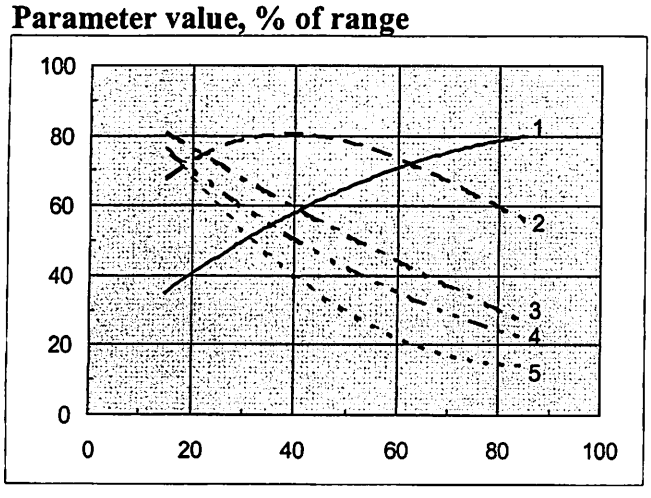
Changes in the source and type of wood/fibre, storage periods and changes in the pulping production process, are also factors that can have a significant effect on the screw press response.

The most important parameters that affect the screw press performance, and that are directly controllable by the operator, are screw speed and counterpressure. These are discussed in the following.

Speed

The speed of the press screw (revolutions per minute, r/min), is the most important parameter that determines capacity and outlet consistency. For a mechanical (gear) drive unit, the speed may be adjusted using alternative pulley ratios for the belt drive. Alternatively, a variable speed drive can be used to control the speed. Both hydraulic and frequency converter systems are applicable.

The following figure shows the typical response of the screw press performance parameters to a change in speed. Note that specific applications can differ in their response depending on pulp characteristics and the operating goals.



Parameter:
1. Production rate, t/day
2. Power, kW
3. Torque, kNm
4. Specific power demand, kWh/t
5. Outlet consistency, %

Figure 10 - Speed Response Parameters

Counterpressure
The primary effect of increasing counterpressure is to increase the outlet consistency. Note that an increase in power demand is also normally associated with increased counterpressure.

The counterpressure can be adjusted both by the position of the counterpressure cone and by the pneumatic flaps.

3.7 Adjustment of the Preceding Equipment

In addition to the pulp characteristics, the process operating parameters related to the operation of equipment ahead of the screw press are highly important. To obtain optimal performance, adjustment of this equipment should be considered. For the screw press, this represents major process changes. Thus, it may also be necessary to re-adjust the speed and counterpressure for optimal results.

Inlet Consistency
Low inlet consistency may cause reduced capacity. Increasing the inlet consistency will normally improve the situation.

Inlet Temperature
Low temperature may cause reduced capacity. Increasing the pulp temperature will normally improve the dewatering characteristics and will therefore give increased capacity as well as higher outlet consistency.

High or Varying Inlet Pressure
If the feed system ahead of the screw press is based on pumping from a pulp tank or chest, the pump characteristics will influence the capacity and may cause operational problems. The effective pump pressure depends on several factors, including the level of the pulp tank, the piping length and diameter and the pulp characteristics.

A periodic or general tendency towards low outlet consistency may indicate that the pulp flows directly through the press without forming a normal plug in the outlet end. This may indicate that the maximum capacity has been exceeded (for the given operating conditions). The inlet valve should be used to reduce the inlet pressure (flow) until normal operating conditions are reestablished. It is not necessary to stop the press.

A too high inlet pressure can also cause fines and fiber to pass through the screen system resulting in a fiber loss to the filtrate water. The inlet pressure should therefore be held as low as is compatible with the production capacity requirement.

3.8 Operating Problems

The following constitutes a process oriented list of possible special problems that can occur on occasion, and the actions that can be taken to overcome them (troubleshooting).

Table 4 - Operating Problems

Problem/Observation	Probable cause	Action
High drive load. Rapid increase in the current of the el. motor with danger of motor overload.	Variations in the inlet consistency, feed rate, or changes in the dewatering characteristics of the pulp.	a) Reduce the pulp flow to the screw press. b) If possible, increase the speed of the press. c) Reduce the counterpressure. d) An automatic relief system can be installed to speed up the press and relieve the counter-pressure momentarily. e) If the press is equiped with a torque controller, this will provide an even load on the press, also when the conditions are unstable.
Overloaded drive. The screw press has stopped. The high pressure screen section is filled with extremely high consistency pulp (plugged press).	Variations in the inlet consistency, feed rate, or changes in the dewatering characteristics of the pulp.	a) Check that the feed valve is shut off. The valve should be closed automatically if the press stops. b) The pulp plug can normally be loosened by reversing the press screw 1 - 2 revolutions. (For just a few seconds to avoid pressure build up in the inlet house). Then the press screw is operated in the forward direction. The press screw must then be operated alternatively in the forward and backward direction, until the plug has been conveyed out through the outlet house, and the screw rotates freely. c) If the "plug" does not loosen during operation in backward/forward direction, it may be necessary to dismantle the divided screen section and clean the press screw.
Rotation of the pulp in the screw press. The pulp discharges into the outlet house in a radial direction at reduced capacity.	Changes in the pulp characteristics. The Pulp characteristics result in low friction between the pulp plug and the screen basket, e.g. high pH.	Install breaker bars. a) Normally, the supplier knows when a particular pulp tends to rotate and, therefore, will modify the press before delivery.
Channeling in the outlet end of the screw press. Low consistency pulp flows out of the discharge end at certain points in the periphery.	Generally, this happens during start-up of the press, and when the speed of the screw is too high in relation to the feed rate.	Reduce the speed of the press screw until a plug of pulp is formed in the outlet. Adjust the counterpressure and the cone.
Excessive loss of fines in the filtrate water (backwater)	Operation with too high inlet pressure and/or too low inlet consistency.	Reduce the inlet pressure or increase the inlet consistency. If these parameters cannot be changed, screens with smaller hole diameter or higher open area may be required.
Leaking water at the openings outside the outlet house (bearing protection space).	Plugging of the internal channels with pulp.	Flush the channels. If necessary, remove the shredder arms for access to the inside of the press screw.

3.9 Recording Data

The following data recording forms are shown as a model for data recording. Recording such data may be useful both for evaluation of the performance of the screw press and as a basis for optimalization. For more intensive data recording periods (for example during the initial two to three months following start-up) the form can be used as is. For routine operation data recording is normally not required at this level. Instead, it may be of more value to carry out a more comprehensive program of sampling and data recording periodically (for example once or twice per year) or as required when changes are made in the pulp type or in the overall process flowsheet.

Table 5 - Data Records - Screw Press / Process

DATA REF.			SCREW PRESS					FLOW DATA		LAB ANALYSIS DATA			CALCULATED PROD.	
No.	Date	Time	Inlet pressure Bar	Screw speed r/min	Counterpr essure bar	Cone position mm	Active screen area %	Inlet flow l/min	Filtrate flow l/min	Inlet consistency %	Filtrate consistency %	Outlet consistency %	Moist kg/min	Dry ton(BD)/day

Table 6 - Data Records - Pulp

DATA REF. No.	PULP CARACTERISTICS Fiber source	Pulp type	Process application	Freeness ml CSF	Temperature °C	Ash fraction %	Other	REMARKS

Table 7 - Data Records - Drive Unit

DATA REF. No.	MECHANICAL DRIVE			HYDRAULIC DRIVE			FREQUENCY CONVERTER				CALCULATED LOAD		
	Current A	Voltage V	Belt/gear reduction ratio	Working pressure bar	Charge pressure bar	Hydr. motor data	Frequency Hz	Current A	Voltage V	Indicated power kW	Power kW	Torque kNm	Specific power kWh/ton (BD)