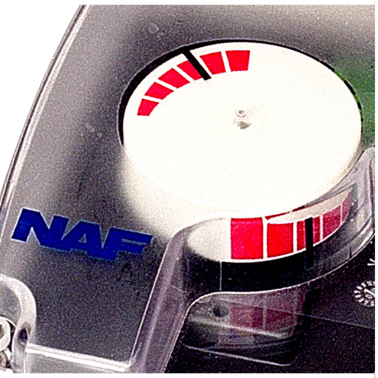
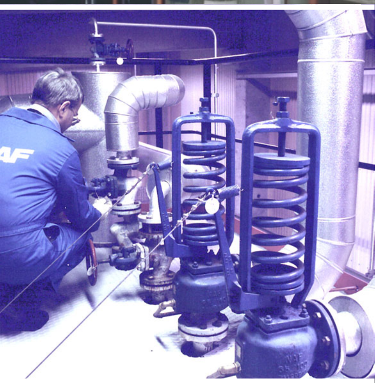
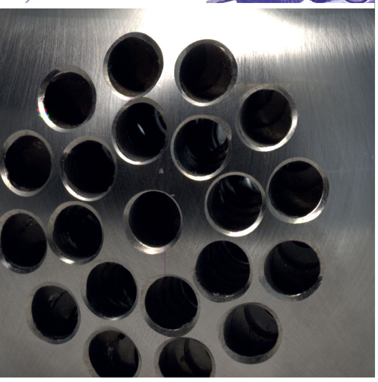
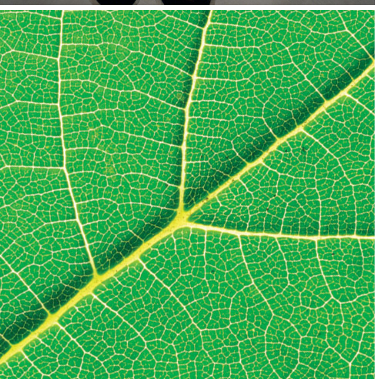
Feel the Flow









Process Information

and valve selection guide Pulp and Paper

Intelligent Flow Control

Pulp and paper

Introduction

24 hours per day, day after day, week after week, month after month. Continuously working with corrosive and erosive fluids under high pressure and at high temperatures. Splashing of pulp and alkalines, vibrations created by refiners and pumps, pressure shocks, crystallisation and scaling, impurities such as sand and metal wires.

It is under these conditions valves installed in the pulp and paper industry have to work and to work properly as a failure will cause tremendous costs.

The pulp and paper industry is one of NAF's strongest areas. The very first NAF valves in the beginning of the 1900's were developed in close co-operation with customers from this industry.

From the beginning we understood the difficulties and have consequently developed our products to fulfil the demands from this industry.

However, to be able to give long trouble-free operation and high reliability, valves must be selected according to the conditions in the application in which they will be installed. This pamphlet gives you some guidance in this difficult task. The final selection will of course depend on the many variables present in the actual service conditions and it is obvious that not all applications can be listed.

Contact nearest NAF representative or NAF, Linköping, Sweden, if assistance is needed.

Chemical pulping

Introduction *(see encl. Fig. 1)*
Chemical pulping is dominated by two processes - the sulphate process and the sulphite process. Each process is designed to produce pulp with specific characteristics.

In sulphate pulping the cooking liquor is alkaline - it has a high pH. The active chemicals are sodium hydroxide and sodium sulphide. The process is named after sodium sulphate, which is used to replace losses of sodium and sulphate.

The sulphite process is named after the active chemical of the cooking liquor, the hydrosulphite ion, also called the bisulphite ion. The base can be calcium, sodium or nowadays mostly magnesium. In sulphite pulping, the cooking liquor is usually acid - it has a low pH. Originally, sulphite pulp was produced with cooking liquor or calcium bisulphite. The calcium base, however, caused precipitates in the system. The chemicals in the spent liquor could not be reclaimed and the organic solids in the liquor could not be economically burnt. The spent liquor was therefore discharged directly out into the recipient. When the pressure from environmental protection grew stronger and the size of the mills began to reach present levels, many sulphite mills were closed down and the remaining ones were converted to magnesium or sodium base.

Cooking *(see encl. Fig. 2-3)*
The cooking processes for sulphate and sulphite are basically the same. In both cases the chips are impregnated with cooking liquor, heated under pressure to 130-170 °C and held at that temperature for some time. Then the pressure and consequently the temperature are lowered and the pulp are blown or washed out of the digester.

There are two main types of process equipment for cooking - the batch digester and the continuous digester. In the batch digester chips and cooking liquor are filled and the contents are heated under pressure according to a specified temperature-time programme. By the end of the programme the digester is emptied - blown - to the blow tank.

The spent cooking liquor containing chemicals and dissolved wood substance is called black liquor. If it is diluted with wash water, it is known as thin liquor.

The steam released in the blow tank is recovered in a blow condensor where it is condensed. The condensate is cooled in a heat-exchanger, whereby a large volume of hot water is produced. This can be used for washing the pulp in the bleaching plant.

In the continuous digester steamed chips and liquor are filled in an even continuous flow into the pressurised digester. The contents is heated up by various circulation systems as it moves downwards. The cooked and partly washed pulp is fed out of the bottom in a uniform flow.
The spent cooking liquor (black liquor) is separated by screens around the digester. The liquor is directed to the flash tanks where the pressure is decreased below the vapour pressure. The generated steam is used for steaming of the chips and the black liquor goes to the evaporation.
The cooking process for both types of digesters is basically the same. Each type has its advantages, but most new cooking plants world wide are built with continuous digesters.

The batch cooking system has been developed during the last years, Superbatch (Sunds) and RDH (Beloit).

These systems work in cycles and use energy from one digester to the next. The advantages are lower energy and liquor consumption. The disadvantages are a more complicated control system and larger wear on the equipment.

The relief gas from sulphate digesters contains turpentine. The gas can be condensed and the turpentine decanted. Turpentine is used as a raw product in the chemical industry.

Washing

The washing process aims at separating the black liquor from the fibres as efficient as possible with a minimum of dilution of the liquor. The equipment used can be continuous diffusers, drum filters, belt washers, wash presses, etc. Washing also takes place in the high heat washing zone of the continuous digester.

The continuous diffuser may be connected directly to the blow line from the continuous digester. The fibre suspension is introduced into the bottom of the diffuser and moves upwards between a number of double sided screen rings inside each other. The wash liquor is added through rotating nozzles. The liquor is extracted through the screens. The displaced liquor is pumped to the continuous digester and used as wash liquor. After washing in the digester and the continuous diffuser, only one more washing stage is generally required.

There are many types of drum filters and all of them work on the same principle. They have rotating perforated steel drum covered by a filter cloth or wire. The drum is partly submerged in a trough containing unwashed fibre suspension. The pressure inside the drum is lower than outside. When the drum rotates, liquor is sucked through the drum and deposit a layer of pulp on the wire. Wash liquor and, in the last stage, hot water is sprayed onto the drum. Filter washers may be arranged in series of three or four stages.

In the belt washer, unwashed pulp is diluted with wash liquor and pumped to a headbox. The dilution water is taken from the suction box under the first stage. The headbox spreads the pulp across a moving, endless wire. Fresh water is sprayed onto the web and goes in counter current back to the headbox.

Screening

Screening systems takes away knots - whether knots or just poorly impregnated chips - and shives - poorly disintegrated fibre aggregates - and fibre bundles.

One of the most commonly used pressure screens with a wide field of applications is the UNI-screen. It has a rotating cage which is kept clean by five stationary foils inside the cage. The pulp is fed in at the top and passes first a waste remover, then moves down into the screen cage. There, acceptable fibres pass through the screen holes. The rejects accumulate and move down to the rejects outlet, where they are diluted to help them leave the screen. Pressure screens normally work with a pulp consistency of 1-3%.

Centricleaners are used to remove bark, short shives, sand etc. A centricleaner is a hollow cone of metal or plastic with a tangential inlet at the top. The liquid entering the cone rotates at high speed and builds an air column in the centre. Heavy particles are thrown by centrifugal force against the wall and down to the reject outlet. Acceptable fibres are drawn towards the centre, where they enter the upwards flow towards the accepts outlet. The centricleaners are mounted in batteries where reject is re-introduced in several stages to minimise the fibre loss. Centricleaners normally work with a pulp consistency of 0.6-0.8%.

The MC-screen is a type of screen designed for a feed consistency of 10-12%. This screen works by fluidizing the pulp. Advantages of MC-screens are a large capacity and the fact that the pulp do not need to be diluted.

In most screening systems, the rejects are screened in a secondary screen. These accepts are re-circulated to the primary screen. Two screens connected in this way are said to work in cascade. The rejects from the secondary screen go to a reject screen - the knotter-washer. The knots are then taken back to the digester for re-cooking.

Bleaching *(see encl. Fig. 4)*
Sulphate pulp is brown why the fibres must be treated with chemicals which can dissolve the remaining lignin - the cause of the brown colour. This is done in the bleaching plant, where the pulp is treated in several stages with oxygen, peroxide and chemicals containing chlorine. Sulphite pulp is significantly lighter in colour and can be used in i.e. newsprint without being bleached.

The number and order of stages used varies with the intended use of the pulp as well as with the local conditions. A bleaching sequence - a connection of bleaching stages - is described with the help of internationally accepted terminology, where each stage or bleaching tower has a letter, indicating which chemical that is active in it:

- C = Chlorination stage
- D = Chlorine dioxide stage
- C+D = Simultaneous injection of chlorine and chlorine dioxide, with chlorine as the dominating chemical
- E = Extraction stage where chlorinated lignin, which is insoluble in water, is dissolved in alkali
- H = Hypochlorite stage
- O = Oxygen stage
- P = Peroxide stage
- T = Dithionite stage
- Z = Ozone stage

Each bleaching stage consists of three parts:

- A mixer to mix in the chemicals and, when needed, steam
- A bleaching tower
- A washer - a drum filter or radial diffuser like those used in the brown stock washing plant - for removal of dissolved products

At the end of each bleaching sequence where chlorine is used, a sulphur dioxide solution is injected into the pulp to neutralise any remaining bleaching chemicals.

Nowadays an oxygen bleaching stage usually precedes the chlorine bleaching plant. This O-stage is generally placed between the screen room and the washing plant.

When oxygen bleaching leads the sequence, the hypochlorite stage is no longer needed.

Prebleaching with oxygen can be performed at two alternative consistency levels - 10-12% or 20-30%, depending on the process after the screen room. Prior to oxygen bleaching the pulp must be made alkaline. This is done by adding sodium hydroxide. The pulp is finely divided and fed into the top of a tower. Here, the reaction time is 30 minutes at a temperature of 80-110 °C.

Chlorine is an efficient and cheap bleaching chemical. When it is used alone, the pulp consistency is normally as low as 3-4%, since the solubility in water is limited. A temperature as low as 25 °C is also desired. The process, therefore, does not fit in very well either with the preceding or the proceeding process stages. Therefore chlorine dioxide is mixed with the chlorine. The temperature may then be increased to 50 °C. At the same time the filtrate from the preceding washer is less harmful ecologically.

During the chlorination, two kinds of chlorinated lignins are formed - one soluble in water and the other soluble only in alkali. The alkali-soluble chlorinated lignins are removed by treating the pulp with sodium hydroxide in the E-stage. In the sulphite pulp bleaching, the extraction stage also removes a part of the wood resin, sometimes with the help of surface active chemicals. The temperature in the E-stage is kept at 40-60 °C for sulphite pulp and above 60 °C for sulphate pulp. The pulp is heated by the addition of live steam in a steam mixer.

In a combined (EO) stage, there will be both decomposition and extraction of lignin. In some cases peroxide (P) is used instead of or together with oxygen. The combination of alkali and oxygen in the extraction process has become a very efficient and economical process.

In the classical bleaching sequence, the E-stage is followed by treatment with sodium hypochlorite, the H-stage. This has, however, been eliminated in modern bleaching plants. Hypochlorite bleaching takes place in an alkali environment. A pH of 9-11 is therefore suitable. The temperature should not rise above 35-45 °C. This all means that the H stage does not fit in with a low-energy bleaching sequence.

Bleaching with chlorine dioxide in the D stage requires a weak acid environment. At a normal temperature of 80 °C the bleaching time will be 3-4 hours. To save heating steam, the consistency is kept as high as possible, generally 10-12%. Chlorine dioxide bleaching has the ability to attack and reduce shives, knots and particles of bark.

Most bleaching chemicals are bought ready to use and are delivered by road or rail. Chlorine dioxide, however, must be manufactured in the pulp mill, since it is too dangerous to transport. It is extremely poisonous and instable and can explode at high concentrations.

Chlorine dioxide can be produced in several ways. In one method, sulphur dioxide gas is introduced into an acid solution of sodium chlorate, in several stages, in special reactors. The residual product is sulphuric acid, which can be used in the pine oil plant.

Sodium hypochlorite is another chemical which can be produced in the mill. In this case, chlorine gas is allowed to react with sodium hydroxide.

Most bleaching chemicals are corrosive. Pipes, pumps and valves are therefore made of glassfibre-reinforced plastics, acid-proof steel or titanium. The bleaching towers are made from steel plates and are protected on the inside by lining of rubber, plastics or acid-proof bricks.

Pulp bleaching technology is currently being developed very rapidly and the research is intensive. Several mills now bleach entirely without chlorine and use chlorine dioxide, peroxide, oxygen or ozone instead.

Evaporation *(see encl. Fig. 5)*
When the diluted black liquor leaves the washing department it contains about 15% dry substances (ds). The evaporation process must increase the dryness to at least 60% in order to make it combustible. This process is referred to as evaporation.

Through a series of evaporators - basically heat exchangers - which operate at progressively lower pressure, the steam from one stage is used to heat the next stage by condensing there. Normally evaporation takes place in five or six stages. These stages are often called effects. Live steam at pressure enters the first effect. The pressure and temperature from effect to drop effect. A condensor and a vacuum pump after the final effect make sure that there is no pressure left. The thin liquor at round 95 °C is pumped into the third effect, which is at the same temperature. Thick liquor is removed from the second. This reduces the risk of incrustations forming on the heat exchanger surfaces. The drop of temperature from effect to effect allows the liquor to boil at temperatures ranging from 140 °C in the first stage to 60 °C in the last one.

The condensate from effect No. 1 is clean and goes back to the boiler feed water tank. The condensate from the other stages can be used in other parts of the process as e.g. wash water. Non-condensable gases are removed and are extracted and burnt.

The thin liquor contains pine soap, which should be recovered. The soap is decanted from the intermediate liquor tank and can be used in a pine oil processing plant for production of pine oil - a raw product for the chemical industry.

Recovery boiler *(see encl. Fig. 6)*
The thick liquor from the evaporation plant is burnt in the recovery boiler - a large steam boiler. This process has two objectives:

- To generate steam for use in the mill by burning dissolved wood substance
- To recover cooking chemicals

During combustion the reaction products between lignin and cooking chemicals are broken down so that further treatment can convert the chemicals back into new cooking liquor. The inorganic chemicals are converted into a smelt and collected at the bottom of the furnace. It contains among others sodium carbonate (Na_2CO_3) and sodium sulphide (Na_2SO_3). The smelt flows out through holes and is dissolved in a liquor from the lime mud washer, known as weak liquor. After the smelter the liquor is called green liquor.

The steam produced in the recovery boiler is economically important to the pulp mill. It provides enough heat to meet the demands on the pulping process and often there is enough steam over to produce electric energy in a steam turbine.

White liquor preparation *(see encl. Fig. 7)*
White liquor preparation is the last part of the recovery process - it is called the causticizing process. Here the sodium carbonate of the green liquor is converted into sodium hydroxide (NaOH) by reduction with burnt lime (CaO). At the same time, lime mud (calcium carbonate $CaCO_3$) is formed. This is separated and washed in a lime mud washer, the filtrate being the weak liquor. We now have new cooking liquor which is called white liquor, although it is really slightly yellow. The washed lime mud is burnt in a lime kiln at high temperature to produce burnt lime once again.

The lime kiln normally uses fuel oil, but several mills also use bark or wood residues as fuel. This fuel is first dried and then pulverized or degasified before being fed into the kiln. The lime kiln is a large, horizontal steel cylinder with a diameter of 2-4 meters and a length of 40-120 meters. The cylinder is rotating 2-3 revolutions per minute and slope 2-3° towards the burner.

Recovery system for the sulphite process
The evaporation system for a sulphate process has been described earlier. The system used in sulphite processes are roughly the same except that there is no soap removal. The wood extractives react differently in the sulphite pulping process and do not produce soap. On the other hand fines, which contain resin, must be removed in the screen room.

The thickened spent liquor is burnt in a special boiler plant and the chemicals are recovered as magnesium oxide and sulphur dioxide. The steam generated is superheated and used as process steam. The magnesium oxide follows the flue gas as a fly ash. It is separated off in an electro-filter and then dossolved in water. At this point, magnesium oxide is added, if necessary, to compensate for losses.

The ash suspension is washed with cold water before being thickened on an ash filter. The resulting filter cake is then dispersed in warm water and heated to 90 °C. The magnesium oxide then converts into magnesium hydroxide ($Mg(OH)_2$). Magnesium hydroxide reacts easily with sulphur dioxide to form magnesium hydrosulphite ($Mg(HSO_3)_2$), which is the active cooking chemical. The suspension is pumped to a number of ventury scrubbers connected in series, where it meets the recovery boiler flue gases in counter current. The liquor is sprayed into the gas current as fine droplets and absorbs the sulphur dioxide.

From the scrubber stage, the solution is pumped to an absorption tower, where it is fortified with sulphur dioxide from the pressure relief of the digester as well as from the burner. The raw acid is cleaned by sedimentation and filtering before being pumped to the pressure accumulators in the digester house. There it is further fortified with sulphur dioxide and cooking acid from the process.

Valve selection in general

Rotary control and on-off valves have been used in almost every type of pulping installation since they were introduced in the beginning of the 1950's. High capacity combined with easy automation and maintenance have been the key factors to the success.

In the digester area the flanged, full-bore type ball valve has great advantages due to its high capacity and good resistance to stress from pipeline. If the flowing media includes chips, stones or similar items, the use of metal seated valves is common.

The consistency of pulp is one criterion in valve selection. Shut-off valves for pulp consistencies of 5% or more should be full-bore valves. In control duty, the ball sector valve has almost become standard. This valve type gives the optimal trim form to avoid clogging and dewatering of the pulp.

Metal seated butterfly valves do an excellent job in steam control and even in some steam shut-off service. These valves are also becoming common in the air evacuation, liquor fill and liquor circulation.

Valve selection for special application

Batch digester *(Figure 2)*

The blow service is one of the most severe valve applications. The sudden release of energy when the valve opens creates high flow velocities and in many cases a severe blow line shock in the line. This line shock creates high peak impact to the blow valves for the other digesters connected to the same manifold. A full bore ball valve with reinforced ball and locked stellite seat rings is often used for this on/off service.
See valve A.

Continuous digester *(Figure 3)*

The valve for feeding of MP-steam is a part of the safety system for the digester. The valve must close if the pressure in the digester exceeds the allowed pressure. Full-bore ball valve with stellite seat rings is used. The valve has a spring return actuator, spring to close and could be locked in closed position.
See valve A.

Switching valves for spent liquor. These valves are exposed to full stroke operations as often as 1 time/120 seconds (262 800 times per year). This together with heavy vibrations and pressure shocks require very good valves. Double eccentric butterfly valves with metallic seats and metaloplastic bearings are used.
See valve B.

Valves for **flashing of black liquor** to the flash tanks are mounted on flanges welded straight to these tanks. When sizing the valves it must be taken into consideration that the medium is in a two-phase condition. I.e. a mixture of black liquor and steam. The flow to each tank is often split up to 25% through one valve and 75% through the other to be able to handle fluctuations at start up etc.
For handling the liquid direct from the digesters are often full-bore ball valves with stellite seat rings used. Butterfly valves with metallic seats are often used for the liquid from tank 1 to tank 2.
See valve C.

The blow valve controls the level in the digester. It works under very hard flow conditions. The pressure drop can be up to 22 bar at a temperature of 160-180 °C. The pulp contains knots, stones, etc, which wear-out the valves fast (6-30 months). Ball valves with cylindrical bore and locked stellite seat rings are used. Stellited outlet or ceramic sleeves can prolong the life-time.
See valve D (the valves are used one at a time).

Bleaching plant *(Figure 4)*

In modern MC (medium consistency) bleaching plants are the control valves mounted directly on the mixing pumps. Ballsector valves are used, some applications can require valves with larger outlet than the standard valves'.
See valve A and B.

Ballsector valves in titanium or other special alloys can be used for the chlorine service.
See valve B.

Evaporation plant *(Figure 5)*
The black liquor is basically waste liquor from the digester and other processes. It´s a combination of lignin, spent chemicals and water. The black liquor prior to evaporation can be handled with double eccentric butterfly valves.
See valve A.

Liquid leaving the evaporation section can have a high solid content up to 70% combined with salt cake and sulphur. Here the full-bore type of ball valve with locked stellite seat is often selected.
See valve B.

Butterfly valves can be used for control service up to 45-50% solids.

White liquor preparation *(Figure 7)*
Here you find very erosive valve services.
Ballsector valves with stellite seats are often used for green liquor.
See valve A.

For not clarified green liquor and lime sludge, full-bore ball valves with stellite ball and seat could be required.
See valve B and C.

Lime mud control is one of the most erosive services. Ball valve with ceramic lining could be used here.
See valve D.

Mechanical pulping

Introduction *(see encl. Fig. 8)*

Mechanical pulping is the name used for groundwood pulps and all kinds of refiner pulps. Groundwood pulp is produced by grinding spruce logs. These are held against a rotating grindstone that is sprayed with water. Refiner pulps are produced mainly from chips of spruce, but some hard-woods and pines may also be used. In this case, the chips are ground between rotating and stationary steel discs with suitable patterns. The chips may be heated or chemically treated before refining. Water is added to produce a suitable consistency in the refiner.

After grinding or refining, the pulp must be cleaned by screening and centricleaning. The reject fraction which is obtained must be upgraded before pulp can be pumped to the paper mill. Sometimes, the brightness must be raised by bleaching.

Grinding

The grinding process is simple compared to chemical pulping. Debarked, green wood is pressed against a rotating grindstone. Fibres, shives and shower water are collected in a pit below the stone, from where the fibre suspension is coarsely screened. The splinters and pieces of wood removed are then treated in a hammer mill or refiner and returned to the unscreened pulp. Filtrate water is circulated back to the grinder.

The magazine grinder is the most widely used type of grinder. The debarked logs are fed from open boxes and pressed against the stone by hydraulic pistons. The grinders are usually placed in pairs, with one motor driving each pair. The grindstones are constructed from curved ceramic blocks bolted to a concrete cylinder.

Refining

A disc refiner consists, in principle, of two discs with patterned surface, a drive motor and arrangements for feeding chips into the space between the discs. The plant can be supplemented with equipment for treating the chips with steam - TMP - and chemicals - CTMP

In a TMP-plant for newsprint pulp, the chips are preheated in a silo with steam. After washing, they are drained as they travel through a screw into a preheater. This preheater is at atmospheric pressure and gives the chips a temperature of 90 °C. The chips are then fed by a screw to the plug screw situated prior to the refiner. This plug screw seals off the system from the atmosphere and the chips are preheated with steam before entering the refiner's screw feeder. The refined pulp, along with the generated process steam, is blown into a pressurised cyclone, where steam is separated off. The pulp is screwed out into an atmospheric tank below. Here, the fibres are allowed to rest in warm water for a few minutes, so that the pulp recovers its natural elasticity. The tank is called the latency tank.

In the CTMP-plant, the chips are deareated, washed and drained as in the TMP-plant. They are then impregnated with 2% sodium sulphite at the point where the chip plug starts to expand after leaving the plug screw in the pressurised presteaming vessel.

Most TMP and CTMP plants built today are two-stage refining. The plate gap in the second stage refiners is rather small if the refiners of both stages are operated at the same chip flow and motor load. Refiners are, therefore, normally built either in groups of four primary and three secondary refiners, or three primary and two secondary refiners. The first stage refiners are pressurised and the second stage refiners are atmospheric.

Screening

The purpose of mechanical pulp screening is to separate off and concentrate, shives and long, stiff fibres in need of further mechanical treatment. The screen rejects are dewatered and refined. The refined rejects are fed into the unscreened main flow from the refiners. All reject is re-introduced after being treated this way.

The screen accepts are pumped to a battery of centricleaners arranged in cascade on the reject side. This process removes small shives, sawdust, bark, sand and grit. Some centricleaner rejects are pumped to the rejects refiner.

Bleaching

Bleaching mechanical pulp does not involve lignin removal as the bleaching of chemical pulp. If brightness has to be increased by only a few units, as in some magazine papers, it may be bleached with dithionite ($Na_2S_2O_4$). Before such bleaching, the pH must be raised to at least 6.5 and metal ions in the pulp must be sequestered by adding a complexing agent.

Dithionite is mixed into the pulp at the bottom of a upflow tower. Stock consistency is round 4% and the temperature up to 75 °C. No washing is required after bleaching.

Bleaching with peroxide (H_2O_2) in one or two stages is necessary when a large increase in brightness is needed. Sodium hydroxide must be added with the peroxide to raise the pH and set off desired chemical reactions in the pulp suspension. Sodium silicate is added to buffer the pH and to prevent decomposition of peroxide, which has a tendency to decompose into oxygen and water. The heavy metal ions must also be sequestered by complexing agents. Peroxide remaining in the pulp after bleaching is recovered by pressing the pulp to a high dryness after the bleaching tower. The water pressed out contains the residual peroxide, which is recirculated to the process in counter current and is used as dilution water. Fresh bleaching chemicals are added in a MC-mixer before the bleaching tower.

Valve selection in general

Most applications for mechanical pulping are not subject to the demanding fluids and environment encountered in chemical pulping. Two valve types - butterfly valves and ball sector valves - can serve the majority of the applications, including steam. Metal seated butterfly valves do an excellent job in steam control and even in some steam shut-off service.

The consistency of pulp is one criterion in valve selection. Shut-off valves for pulp concentrations of 5% or more should be full-bore valves. In control duty, the ball sector valve has almost become standard. This valve type gives the optimal trim form to avoid clogging and dewatering of the pulp. If the flowing media includes chips, stones or similar items, the use of metal seated valves is common.

Valve selection for special applications

When the throttling differential pressure is high, i.e. for pressure control in (C)TMP-refiners, low-noise ball valves are recommended. NAF-Trimball provides gradual pressure reduction which solves many of the problems with noise, cavitation and erosion.

Paper making

Introduction *(see encl. Fig. 9)*

Paper is manufactured by mixing fibres in water and pretreating - beating - them in suitable ways. The resulting stuff is diluted with the circulating process water from the paper machine and is ejected as stock at about 0.5% consistency on to an endless, permeable metal or plastic fabric on which it is uniformly distributed. The fabric is called the wire. The speed of the wire is adapted to the velocity of the stock hitting it.

As the water is drained and sucked away, the sheet begins to form on the wire. Dry content increases to about 20% at the point where the wire turns back and the sheet is transferred to the presses. From the wire the sheet is transferred on to press felts, which carry it into nips between rotating rolls, where more water is pressed out and the dry content is raised to 35-50%. The remaining water is then removed by one or more steam-heated cylinders, resulting in a final dryness of 90-95%.

Pulping and deinking

Mills that are not integrated with a pulp mill buy their pulp in bales that are slushed in a pulper so that the fibres can be pumped to a high-density storage tower. Recycled waste is also supplied in bales and is slushed, but has to be cleaned after slushing far more carefully then baled pulp. Deinking may also be necessary.

A common type of pulper has the shape of a hemispherical tank with a screw rotor and an extractor plate at the bottom.

A system for pulping, refining and deinking of waste paper consists of a continuous pulper, a high-density cleaner to separate the coarse contaminants, a deinking and a fiberizer that can break up fibre knots and remove plastics and minor contaminants.

Waste paper is dumped from a conveyor belt into the pulper. Backwater from the paper machine is added continuously for consistency adjustment to 3-5%. Sometimes chemicals are added. Heavy contaminants are sluiced out from a scrap pocket, but light contaminants concentrate in the middle of the pulper and are removed by means of a deragger rope. The pulp goes from the pulper to the beater chest for consistency adjustment, and is pumped from there through the thick pulp cleaner to the deinking vessel(s). Deinking is fundamentally a laundering process similar to washing cloths and ink, resin, is removed from the fibres by means of adding different chemicals like surfactant (detergent), caustic soda, sodium peroxide and sodium silicate (Na_2SiO_3). After the deinking the pulp is washed and sometimes bleached with hydrogen peroxide (H_20_2) and screened. The final preparation takes place in the thickener where the pulp is dewatered to required consistency.

Stock preparation

To yield strong paper the virgin pulp has to be treated so that the fibres can absorb more water and can bond more easily. Disc and conical refiners are used for beating in the stock preparation plant. Mechanical pulp is not beaten as it already has adequate sheet-building properties. Neither are recycled fibres beaten as they are already refined.

After refining, the stock is diluted and different types of stock are mixed. Broke as well as additives may also be introduced. This mixing takes place continuously in proportion to the main flow. Stock consistency is adjusted to about 3% in the machine chest.

Screening

After the stock preparation the stock has to be cleaned from contaminants such as plastics and sand that might have entered the furnish and from metal particles from the beating equipment. Furthermore, the stock has to be diluted to the consistency required in the headbox, maybe 0.2-0.4%.

The additives common for most paper grades are rosin size to make the paper less water absorbent and alum (aluminium sulphate) to help the size particles adhere to the fibres. Starches are added to increase the strength and stiffness of the paper. Fillers such as kaolin and chalk are used primarily in fine paper and at proportions up to 30%. There are also other additives such as dyes, de-foamers and retention aids. All additives are proportioned to the main flow and added at different points in the approach flow, depending on weather an early or later effect is required.

Paper machine

All paper machines consist of the following main sections:

- The forming section, where the stock is dewatered through one or two wires to a dry content of about 20%.This section consists of a headbox, a wire section and a backwater system.
- The press section, where the sheet is dewatered by pressing to a dry content of up to 50%. This section consists of press rolls in different configurations and is also connected to the backwater system.
- The dryer section, where the sheet is dried on one or several cylinders to equilibrium with the surrounding air, i.e. normally 90-95% dryness.

Paper machines can be grouped into basic types depending on the design of the forming section:

- Fourdrinier machines, where the sheet forming and dewatering take place on a flat, horizontal wire with drainage elements underneath that scrape and suck water from the forming sheet on the wire.
- Twin-wire machines, where the stock is fed in between two wires - often upwards - and the dewatering takes place in one or two directions.
- Hybrid machines, that have a Fourdrinier wire for initial drainage and a top wire for further drainage.

Paper machines can also be classified according to the design of the dryer section:

- Multi-cylinder machines with many drying cylinders, 40-100, with diameters of 1.5-1.8 meters
- Yankee machines with one dryer, 4-7 meters in diameter
- Combined machines with one or two multi-cylinder sections and a Yankee dryer

Paper grades

Newsprint

Newsprint is an unsized printing paper mainly containing mechanical pulp. TMP or stone groundwood pulp (SGW) offer high opacity and rapid absorption of printing ink. The addition of 10-20% CTMP pulp increase the strength of the paper. The thinner the paper, the more reinforcement pulp must be added. Fillers are sparsely used. If sulphite pulp is being used for reinforcement, some talc may be added to reduce pitch problems.

The chemical pulp, as well as slushed broke and recycled fibres, are proportioned to the main flow of mechanical pulp. A bleaching chemical may be added to the mixing chest. Most modern newsprint machines have twin-wire units.

Magazine paper

Magazine paper is manufactured with a high content of mechanical pulp and 6-30% fillers. It can be coated or uncoated, but it is always supercalendered. It is often produced on original newsprint machines with a Fourdrinier wire or on hybrids.

Light-weight coated (LWC)

LWC is a coated paper with about 60% bleached mechanical pulp as base and the balance of bleached kraft. Filler in the broke gives ash contents of about 6%. It is produced on high-speed, twin-wire machines and normally coated on the machine with one blade on each side.

Fine paper

Fine paper is often described as a range of writing and printing paper of high quality manufactured of bleached chemical pulp. Generally the amount of mechanical pulp is limited to 10%. White filler, i.e. kaolin, improves opacity and surface uniformity and sometimes also brightness.

The different pulps are treated separately in different stock preparation lines. Fillers and additives help the production. The addition of size makes the paper less water-absorbent, but not water-proof. Sizing can take place in acid conditions with rosin size and alum, or in slightly alalkaline systems with starch and polymers. With acid sizing at a pH below 5, kaolin must be used as a filler because the alternative filler, calcium carbonate, dissolves in acid backwater. Kaolin is more expensive than carbonate, i.e. limestone, chalk or marble. Chalk gives a matt, bright paper. Titanium dioxide is a white filler with very high light refraction. Modified starches can be added to increase the strength of the paper

In fine paper manufacturing, there are two types of machines used:

- Fast hybrid or two-wire machines for bulk grades
- Small specialized machines producing a range of high-grade papers. Fourdrinier machines are common in this application.

Surface application of starch or starch mixed with fillers or other coating materials can be implemented in several ways in sections before the after-dryer and size press. To avoid starch deposits on later rolls, an infrared dryer can be installed before the after-dryer.

The paper is supercalendered for a high gloss or calendered by a matt calender for matt paper.

Kraft paper

Kraft is the collective name for paper manufactured of unbleached softwood sulphate pulp - kraft pulp. It is the strongest paper that can be produced and includes paper for multi-ply sacks, single-wall bags, wrapping paper, OTC (one-time carbon) and cable paper.

Sack paper is made of pure unbleached softwood sulphate pulp of the highest possible yield. Small amounts of rosin, alum and starch are added. The stock is prepared in two stages - a high-consistency stage with HC refiners and a low-consistency stage. Sack paper is normally manufactured on Fourdrinier machines.

Wrapping paper is manufactured on Fourdrinier machines with a Yankee dryer. One side of the paper adheres to the Yankee and receives its characteristic glossy surface. OTC is also made on Yankee machines from unbleached softwood and hardwood pulp in about equal amounts. Cable paper is used for insulating electrical cables and is manufactured of extremely pure unbleached softwood pulp, which is used with de-ionised mill water.

Tissue

Tissue is creped paper for household use and for sanitary purposes. Only chemical softwood pulp is used for the highest grades as this gives soft and strong paper with very good absorption properties. Thoroughly deinked and cleaned recycled fibres from mainly newsprint waste can be used up to 80-90% with some reinforcement of CTMP pulp.

Modern tissue machines are fast Yankee designs with a roll former. Creping is performed by doctoring the paper off a Yankee dryer.

Board and cartonboard

The top ply on folding boxboard is usually made of bleached softwood and hardwood sulphate pulps. If there is an underliner, groundwood pulp is often used. A special coarse mechanical pulp is used in the middle plies.

The operation of the stock preparation plant in a board mill producing multi-layer is a complicated process. Many different kinds of stock are made with different treatments and additives.

Board and cartonboard are manufactured on cylinder vat or Fourdrinier machines, or on combinations of these two. The classic method is to produce board on cylinder mouldes, because originally thick sheets could not be made on Fourdrinier wires.

Glazed board is hardboard used for construction purposes. Like cable paper, it is made of unbleached sulphate paper of high purity. The wet sheets are pressed under high pressure into board with good mechanical properties. It is used in suitcases, shoes, car door liners, back of TV sets, etc. Container board is often called solid board and is usually waxed or plastic laminated, and is first glued together from sheets of 350-1200 g/m^2. The glue functions as moisture barrier. Postcard board is the collective name for a number of bleached, coated boards for high-class printing within a very wide grammage range. Two layers are often glued together with the coated sizes outwards.

Valve selection in general

The majority of paper mill applications are not subject to the demanding fluids and environment encountered in pulp mills. Two valve types - butterfly valves and ball sector valves - can serve the majority of paper mill applications, including steam. Paper mills can make remarkable savings in their valve selection by concentrating on these two types and use the same type of actuators and positioners on all valves.

When the throttling differential pressure is high, low-noise ball valves are recommended. NAF-Trimball provides gradual pressure reduction which solves many of the problems with noise, cavitation and erosion.

Valve selection for special applications

(see encl. Fig. 9)

The stock preparation process includes several consistency control loops with water dilution valves. A perfect application for ball sector valves. In many cases the final furnish of the paper machine is a mix of different pulps. They are mixed in a stock blending system, where the flow of each pulp line is controlled by ratio controllers. This control loop requires high repeatability and accuracy - another perfect application for ball sector valves.
See valve A.

In vacuum service, line dimensions are large and a butterfly valve is the most economical final control element. The same applies to large sizes in screening, centricleaning and where the stock consistency is below 5%. Butterfly valves can also be used for shut-off and control of steam.
See valve B.

The demands of basis weight control are so critical that in most cases pneumatic actuators and positioners do not provide the accuracy needed. For this important control loop a step motor driven special designed actuator in combination with a ball sector valve is recommended. This combination offers high accuracy and movements without hysteresis.
See valve C.

Careful consideration must be given to valve selection for additives used in the paper production. Fillers, like clay, cause wear and erosion. These services require a hard-facing option for metal seated ball sector valves or valves with ceramic inserts. When designing these control loops the differential pressure and the flow velocity should be kept low.
See valve D.

General services

Water system

The pulp and paper industry uses large quantities of water - the consumption could be as high as 500 m^3/ton bleached paper. Although some water can be used directly from its source in such areas as turbine condensers and log flumes, much of the water must be conditioned in some way before use.

Water treatment processes and equipment vary widely from mill to mill, depending not only on the quality of the source, but also on the quality of the water required by the product being manufactured. Nearly all surface water and some ground water supplies are turbid and coloured by finely divided suspended matter. These impurities are usually of such nature that even after extended periods of time, they will not settle out completely. The most common method of removing these impurities is by coagulation, followed by sedimentation and filtration.

Coagulation is the addition of chemicals, usually alum, under controlled pH conditions, to remove finely divided or colloidal suspended matter. The introduction of the coagulant chemical affects the surface charge of the particles causing them to come together into large, dense masses called floc, which will settle out more readily. Coagulation is followed by sedimentation, where under quiescent conditions most of the floc settles out, the remainder to be removed by filtration. Filtration removes the remaining flocculent material - slit, clay and algae. Filtration consists of passing the water through a bed of sand and gravel. The filtered water then flows to a clear well, to be stored until demanded by the process.

Waste water treatment

During the early days of the pulp and paper industry, the discharge of untreated effluent was tolerated because of the relatively small volumes involved and the ability of the water ways to easily assimilate these flows. But times have changed. In recent years, with rapid expansion of the industry and increasing competition for the use of our rivers and streams, this practice has become unacceptable. Encouraged by the public and enlightened management, the paper industry has increased its emphasis on the treatment of its effluents.

The selection of a satisfactory waste treatment system for a mill has become just as important to its economic health as other primary factors such as adequate wood, transportation, good water, and qualified personnel.

Waste water treatment is usually accomplished by some combination of the following processes:

- Recovery of fibres by filtration, normally in disc filters
- Primary treatment by coagulation and sedimentation to remove suspended matter
- Secondary treatment by one of a number of biological processes, such as activated sludge filter, to remove oxygen demanding material.
- Lagooning for final settling and polishing

The activated sludge process is a biological process in which nonsettling substances occurring in dissolved and colloidal form are converted by micro-organisms to a settling form. The settled material that develops is called activated sludge. Aeration is necessary as the bacteria and other micro-organisms which make the sludge must have oxygen for their life processes. The aerated mixture passes a final settling tank in which the activated sludge is separated, leaving a clear liquid to be discharged to the receiving water course.

Air system

Air is used to manoeuvre and control many systems in the pulp and paper industry. Some examples are the head box pressure, the pressure between the rolls in the paper machine, discharge from the chlorine tanks, aeration of lagoons, etc, etc.

Another area where air still is used is for manoeuvring final control elements such as control valves. Even if most of the instrumentation is electronic, most of the valves use pneumatic actuators.

Most mills operate two independent air systems. One for process equipment requiring compressed lubricated air - process air, and another for instrumentation requiring dry, clean non-lubricated air - instrument air.

Valve selection in general

Two valve types - butterfly valves and ball valves - can serve the majority of the general service applications. Butterfly valves, metal seated or soft seated, do an excellent job in the water and waste water treatment plants, while ball valves could be used for almost all applications for sealing water, cooling water, process air, instrument air, etc.

NAF AB
SE-581 87 Linköping
Sweden
Visiting address: Gelbgjutaregatan 2

Telephone +46 (0)13 31 61 00
Facsimile +46 (0)13 13 60 54
Telex 50069

A Siebe Group Company

Chemical Pulping

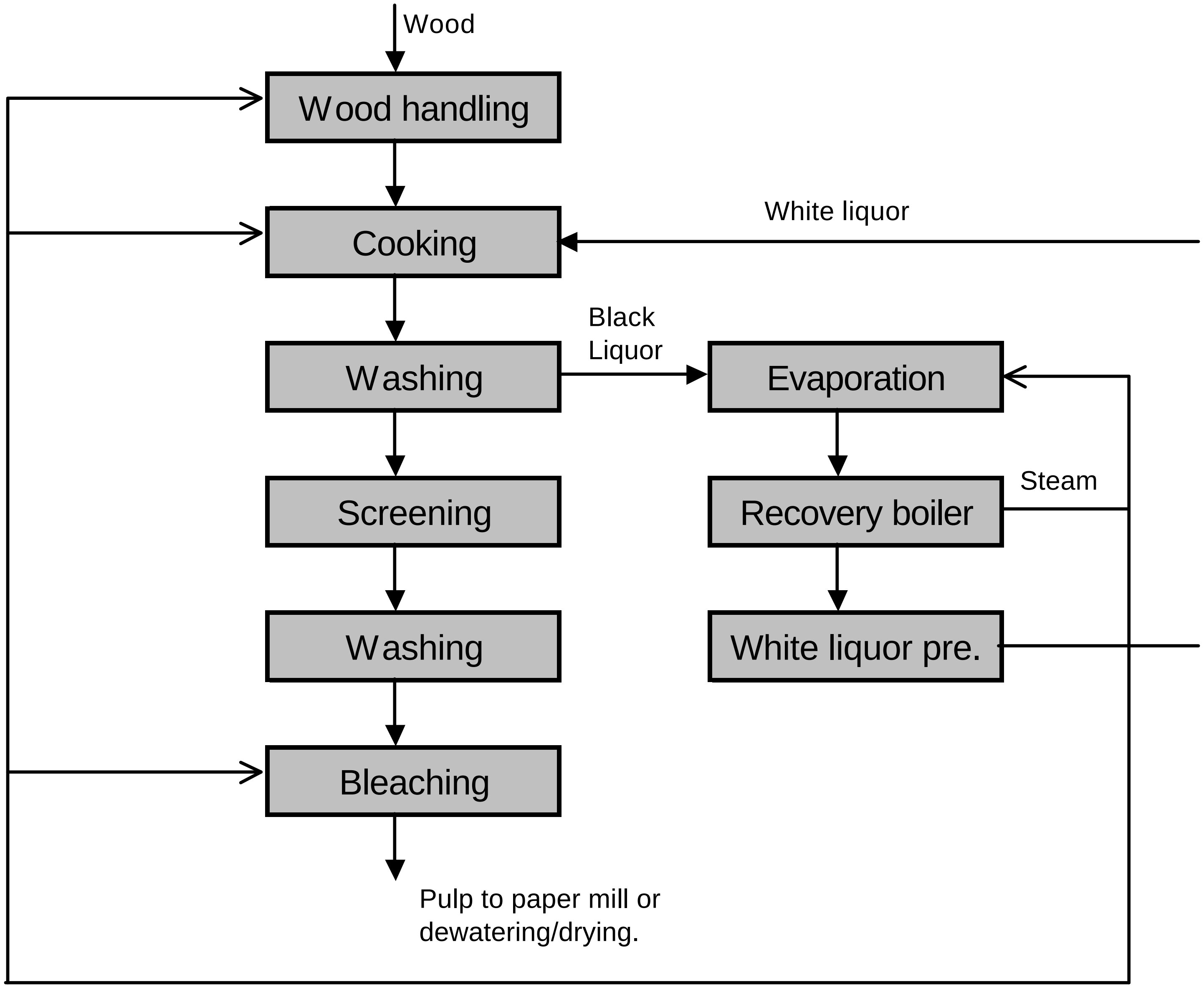


Figure 1

Batch digester (Sulphate)

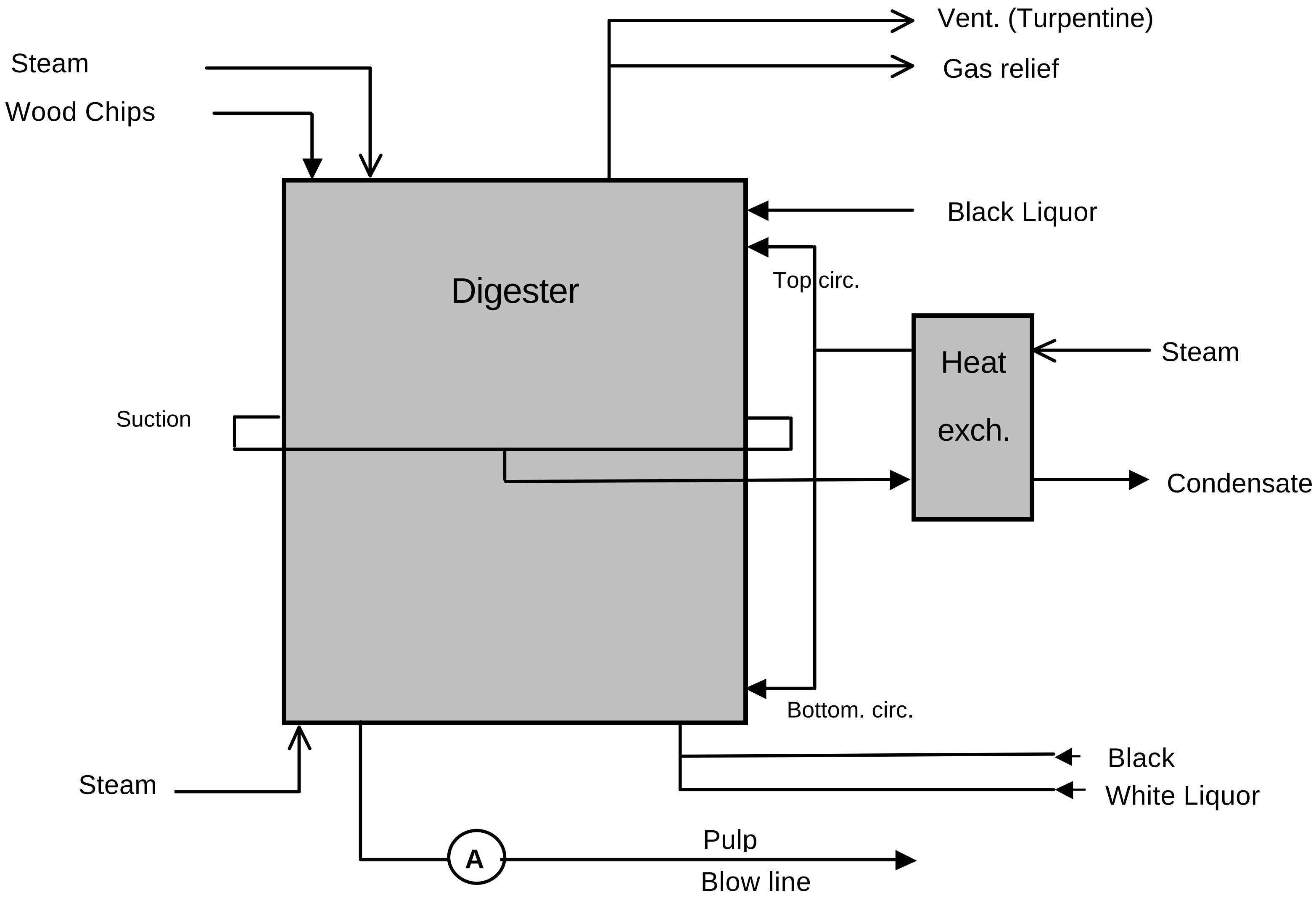


Figure 2

Continuous Digester

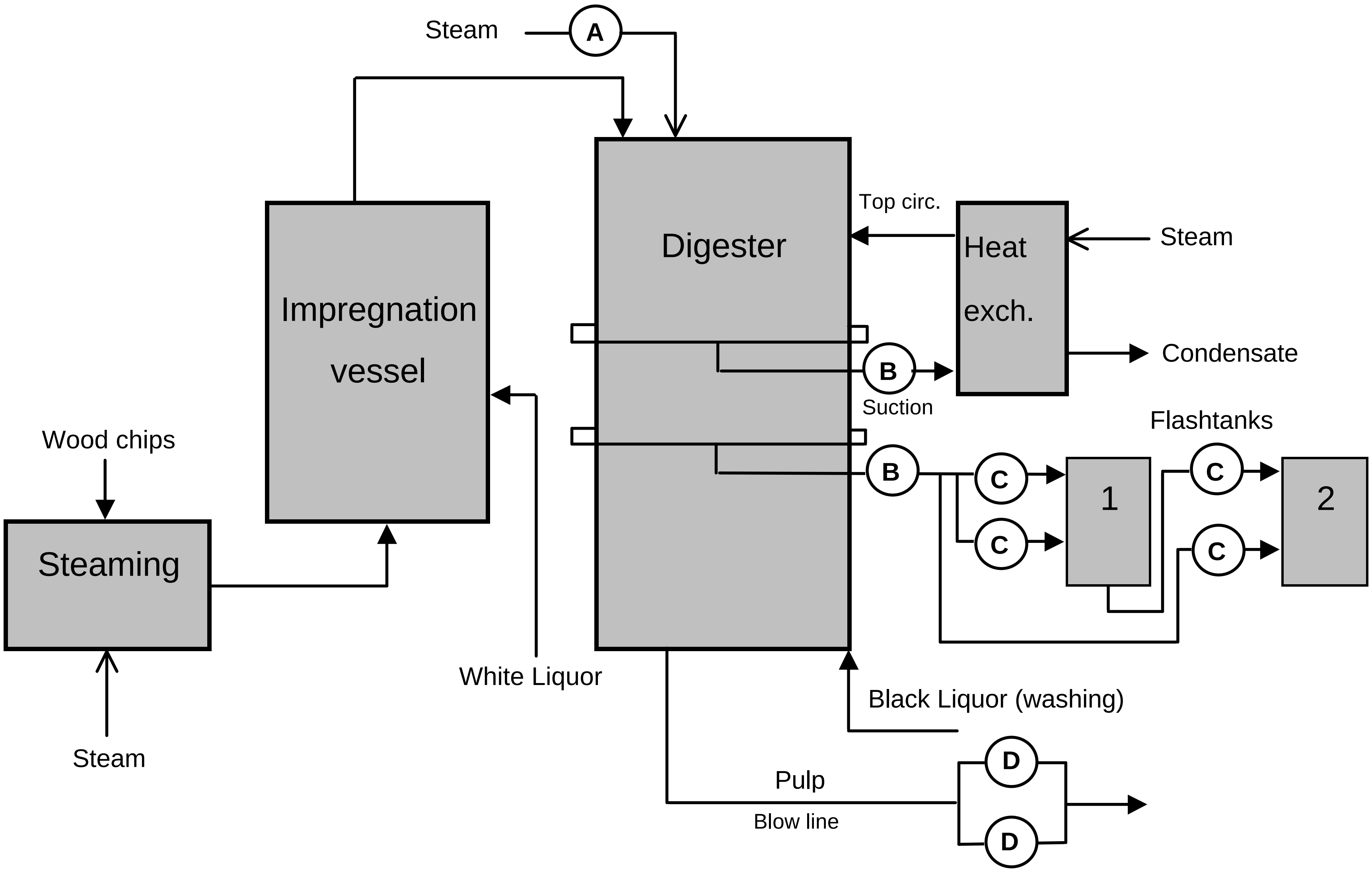


Figure 3

Bleaching

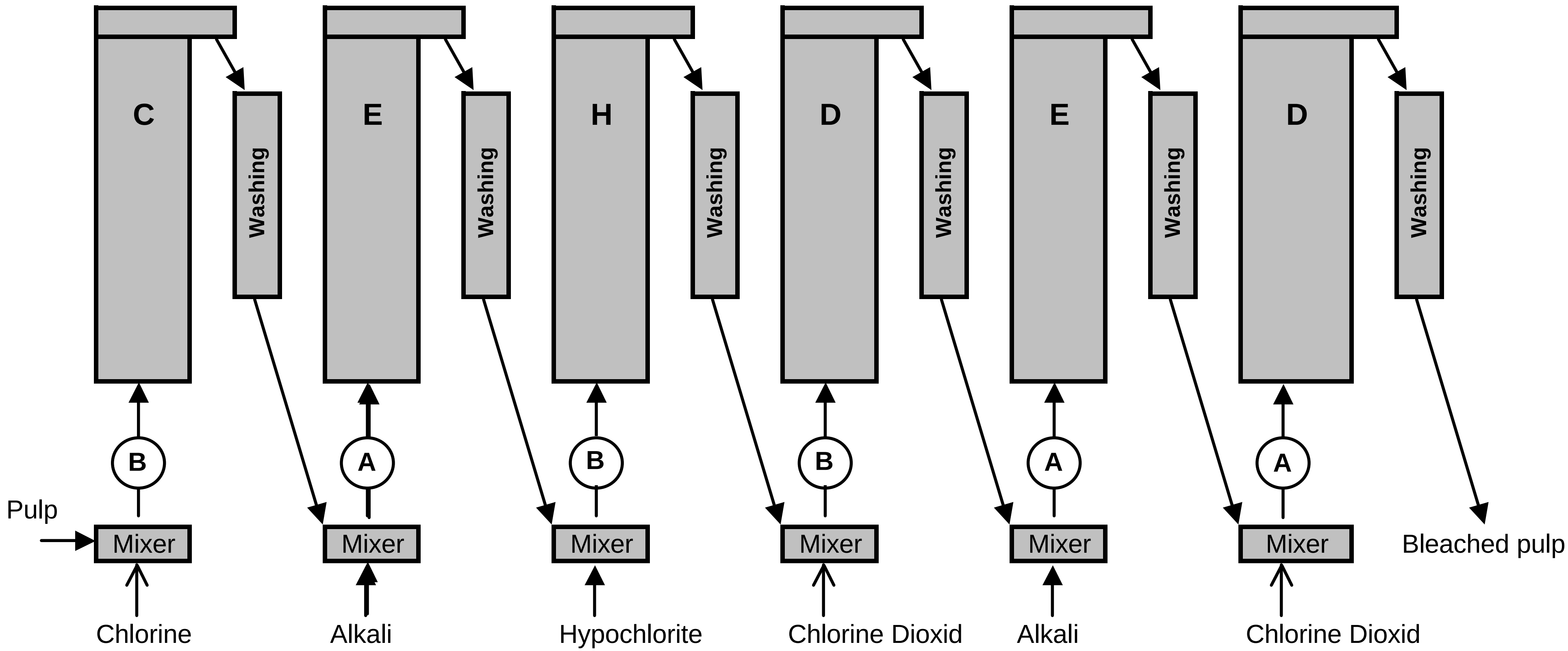


Figure 4

Evaporation

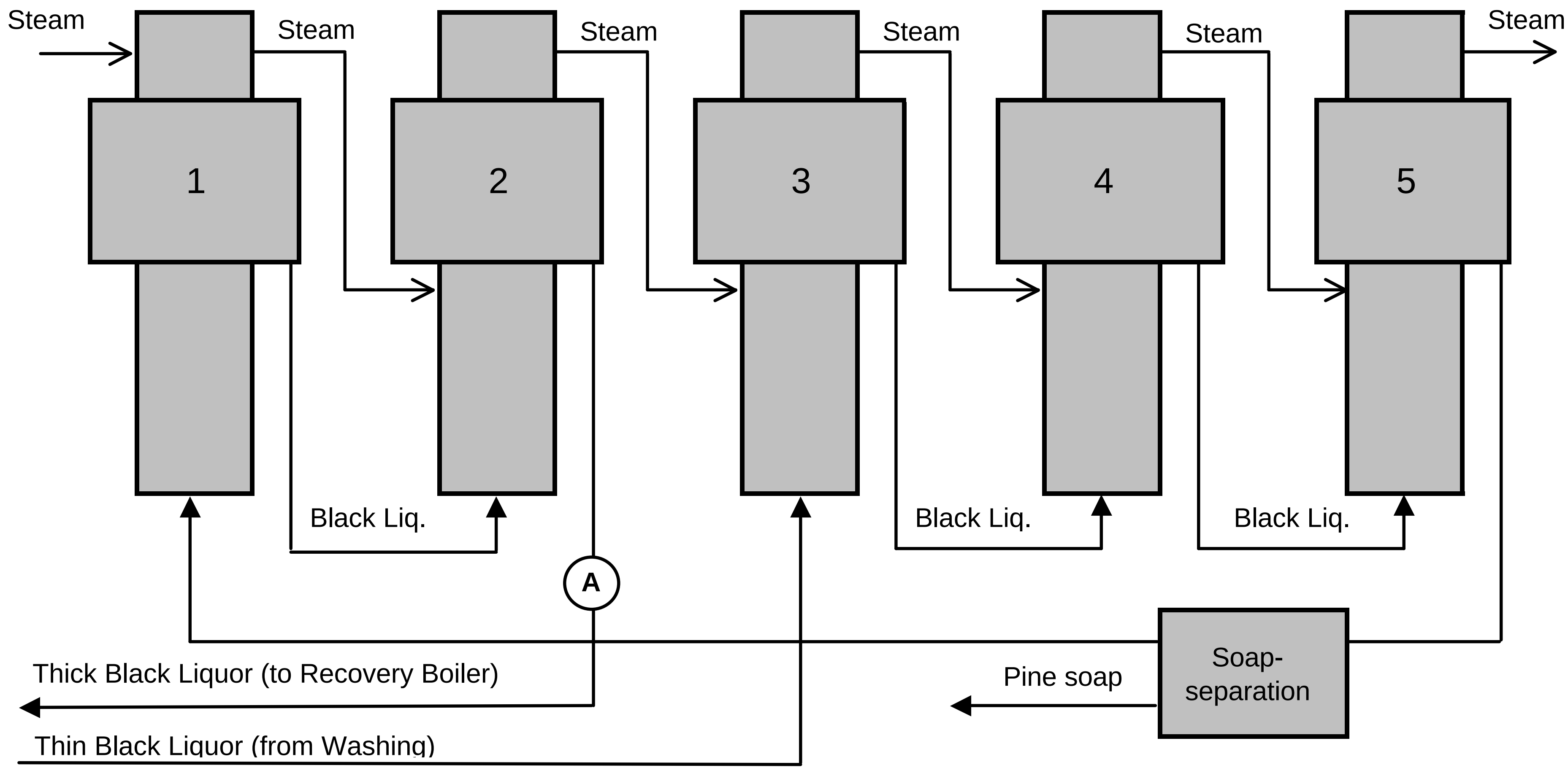


Figure 5

Recovery Boiler

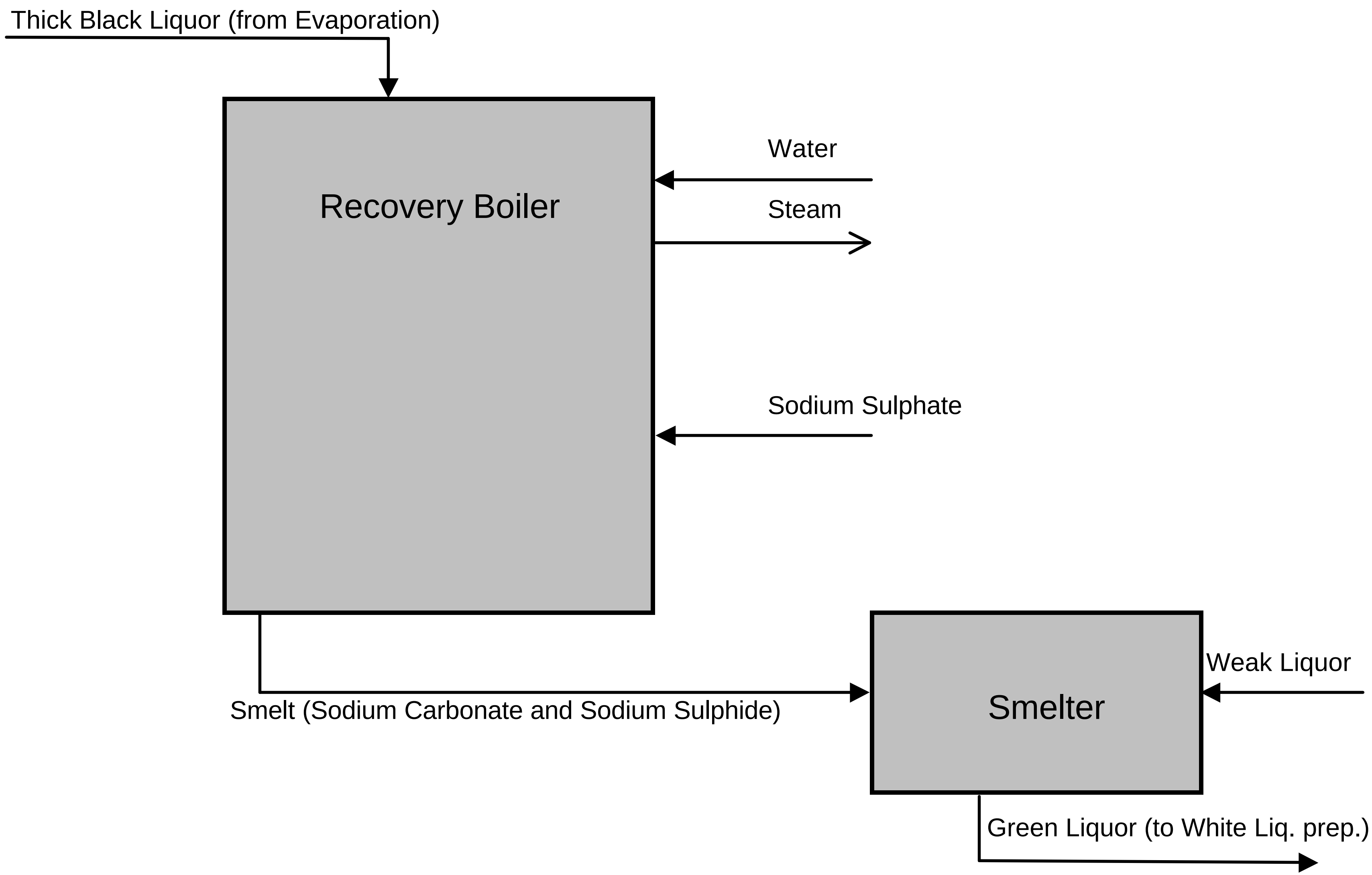


Figure 6

White Liquor preparation

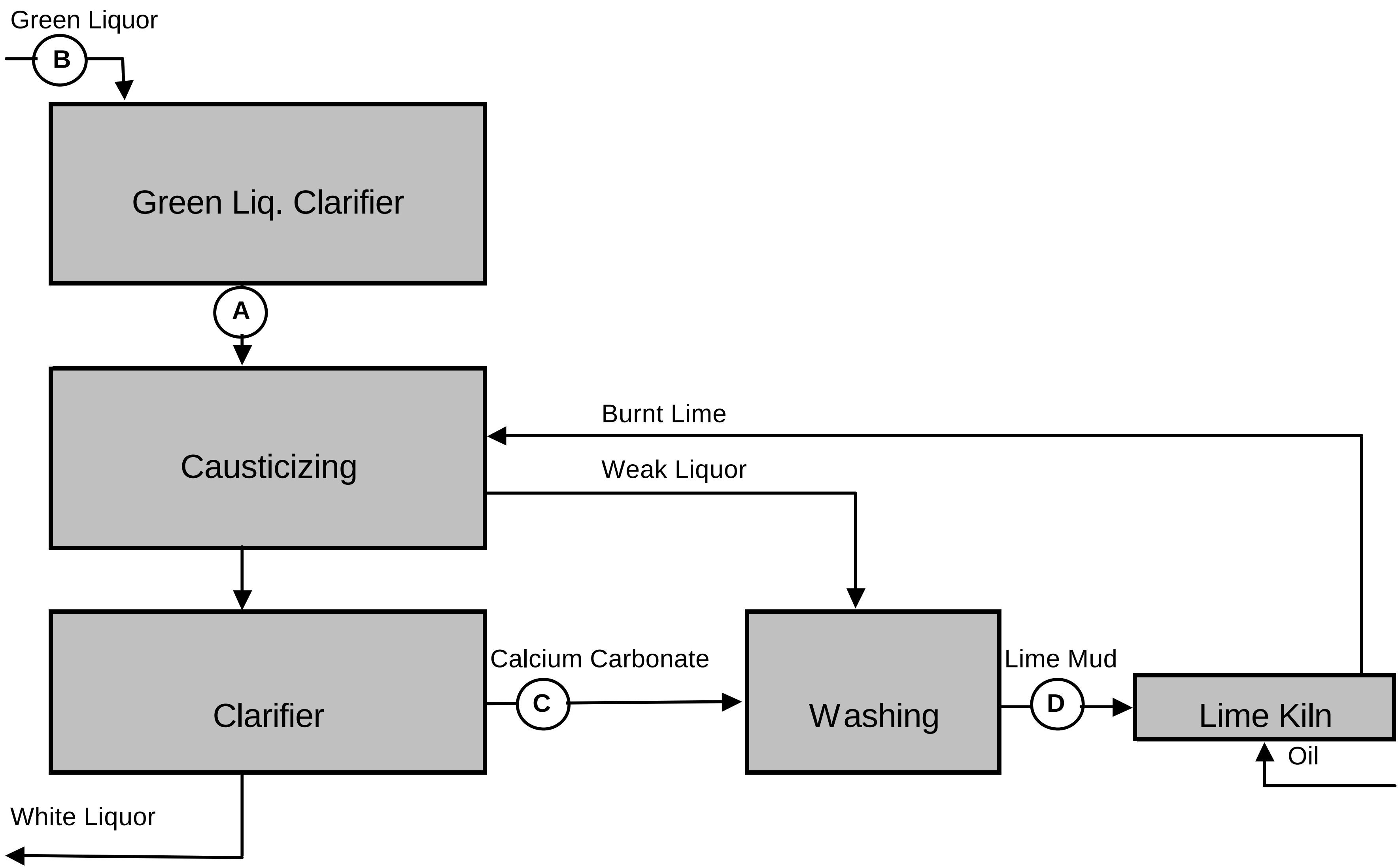


Figure 7

Mechanical Pulping

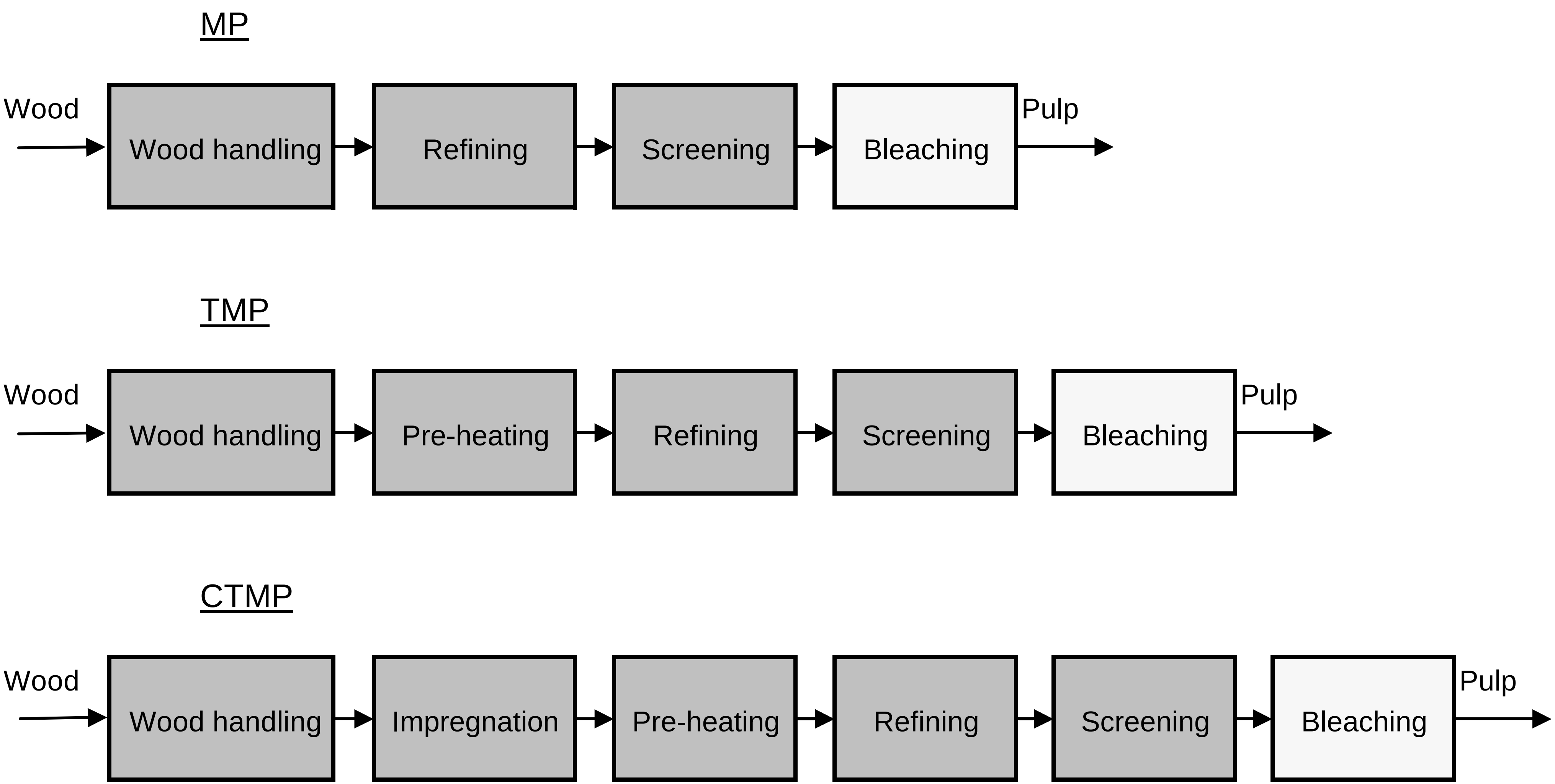


Figure 8

Paper making

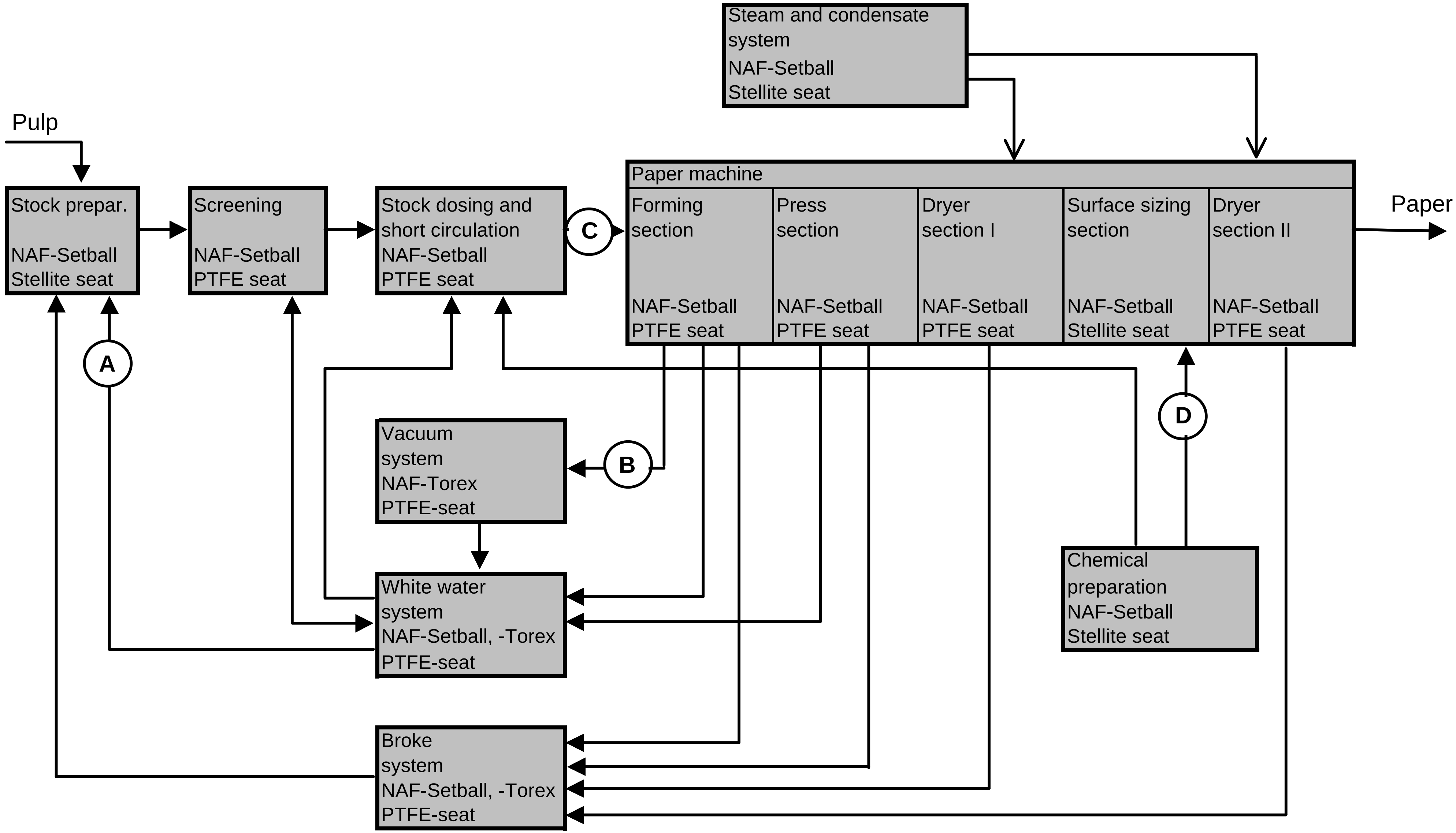


Figure 9

NAF

General Valve Selection Guide
P&P Applications

The recommendations are intended to give only a general indication on which valve types to use. Each valve has to be selected for the specific application.
NAF AB reservs the right to make modifications without prior notice. Pressure/temperature limits according to the data sheet.

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Acetone		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Acetic acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	59
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	59
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	59
Acetylene		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Air (Process)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	48
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	48
Air (Instrument air)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	2
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	2
Air (Vacuum)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	1
	x	x	x	NAF-Torex/Unex butterfly valve	DN80-1000/3"-40"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	1
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Air (Service air - not dry)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	2
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	2
Air (Oilmixed)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Alum		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Aluminium acetate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Aluminium chloride		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Hastelloy C	Hastelloy C	PTFE*	Fk 41.51	20
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	Hastelloy C	Hastelloy C	PTFE*	Fk 41.61	20
Aluminium nitrate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Aluminium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	50
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408	PTFE*	Fk 41.61	50
Aluminium hydroxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	53
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Ammonia, gas		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	43
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	61
Ammonium bisulphide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Ammonium bisulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	16
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	16

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat
Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Ammonium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Aniline		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	32
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	32
Argon	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Backwater- see White water												
Barium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	52
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Bentonite, slurry	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5
Black liquor, <45%		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408	PTFE*	Fk 41.61	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Black liquor, 45-75%			x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	25
Black liquor, >75%			x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4470	EN 1.4470 chemnickel	Ceramic	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4470	EN 1.4470 chemnickel	Alloy 6	Fk 41.61	55
Butyl acetate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Calcium bisulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	62
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	62
Calcium carbonate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Calcium chloride	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Hastelloy C	Hastelloy C	PTFE*	Fk 41.51	
Calcium hydroxide	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Hastelloy C	Hastelloy C	PTFE*	Fk 41.51	
Calcium hypochlorite	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	
Calcium nitrate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Calcium stearate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Calcium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Carbonic acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	39
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Carbon dioxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Carbon monoxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Casein solution		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	32
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	32
Chalk, slurry	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5
China clay, slurry	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5
Chlor gas, dry		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	14
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	14
Chlor gas, wet		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	
Chloric acid	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	
Chlorine dioxide gas, dry	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	29
Chlorine dioxide gas, wet	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	
Chlorine dioxide solution	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	Pure PTFE*	Fk 41.51	
Chlorine water	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	28
Clay		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	5
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	5
Colour		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	32
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	32
Combustion air		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Condensate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	36
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	36
	x			NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	36
Condensate - sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Condensate - sulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Condensate - turpentine		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	45
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	45
Defomers	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Detergents		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Diesel oil		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Dispersing agent		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	2
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	2
Dye		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	2
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	2
Fatty acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Ferrous nitrate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Ferrous sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Feed water		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Formalin		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Fuel oil		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Glue		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	3
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	3
Glycerine		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Glucose		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Glyco		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Green liquor clarified			x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	26
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	26, 56
Green liquor not clarified	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-41	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5,56
Hardening agent		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Hydrochloric acid <30%	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Hastelloy C	Hastelloy C	PTFE*	Fk 41.51	
Hydrogen peroxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	4
Hydrogen sulphide, dry gas 4%		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Hydrosulphuric acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Hydrazine		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	32
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	32
Latex Acryl/PVAL		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Latex SB		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Lime and green liquor	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5
Lime sludge	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	24
Lime milk	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	5
Lime mud	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	Alloy 6	Alloy 6	Fk 41.61	5

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Lubricating oil		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Magnesium bisulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	62
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	62
Magnesium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Magnesium sulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Methane gas		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Naturalgas		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Nitrogen, clean		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Nitrogen, oilmixed		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Nitric acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	39
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Nitrous acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	39
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
NSSC liquor		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Optical brightener		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Oxygen, gas		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	13
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	13
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Ozone		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	Pure PTFE*	Fk 41.51	13
		x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	Pure PTFE*	Fk 41.42	13
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	Pure PTFE*	Fk 25.622	13
Paraffine	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
Phosphoric acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	39
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Pine oil		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	45
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Potassium bicarbonate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve O = On/Off valve C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

NAF

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Potassium carbonate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Potassium chlorate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Potassium hydroxide	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	27
Potassium nitrate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Potassium permanganate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Potassium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Pulp		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	6b, 7
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 Hcr	Alloy 6	Fk 41.61	6b, 7
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	6a, 7
Pulp (Stock/Broke)		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	6b, 12
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 Hcr	Alloy 6	Fk 41.61	6b, 12
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	6a, 12
Red liquor	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
Reject		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 Hcr	Alloy 6	Fk 41.51	7
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	7
Retention aids		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Rosin		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	51
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	51
Sequesting agent		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	8
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	8
Sewage		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
Sewage, cleaned		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Size		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Soap		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium acetate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat
Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

NAF

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Sodium aluminate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Sodium bicarbonate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium bisulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	19
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	19
Sodium bisulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Sodium carbonate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	40
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium chlorate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium chlorite	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	
Sodium dithionite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	44
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	44
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium hypochlorite	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	Titanium	Titanium	PTFE*	Fk 41.51	46
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	46
Sodium hydrosulfite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	16
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	16
Sodium hydroxide =< 50% 60°C	x	x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	61
Sodium nitrate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium peroxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	4
Sodium phosphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium silicate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium sulphate		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sodium sulphite		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Softener		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Stack gases		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	58
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	58
Starch		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Steam		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	60
		x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
			x	NAF-Trimball low noise ball valve	DN50-500/2"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.65	60
Sulphate liquor	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	23
Sulphate soap		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sulphate soap skimming		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sulphur dioxide gas, dry		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	54
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	54
Sulphur dioxide liquid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Sulphurous acid => 96%, < 50°C		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	10
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	10
Sulphurous water		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	57
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	57
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	57
Sulphite cooking liquor	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	18
Talc slurry		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
Tempering agent		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	32
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	32
Titanium dioxide slurry		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	5
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	5
Trichlorethylene		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Turpentine		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	45
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Ventilation air		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
		x	x	NAF-Trimball low noise ball valve	DN50-200/2"-8"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.65	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

NAF

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
Water, chem. purified		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, demineralised		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, drinking		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, fire fighting		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, mech. cleaned		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, raw		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Water, softened		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	230	EN 1.4408	EN 1.4408	PTFE*	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Waste water, alkaline		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Waste water, fibrous		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
Waste water, mud		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
Waste water, acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
Wax		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	11
	x	x		NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.61	11

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

M = Manual valve   O = On/Off valve   C = Control valve

General Valve Selection Guide
P&P Applications

Fluid	M	O	C	Valve type	DN/Size	Pressure class	Max.temp. °C	Materials: Body	Trim	Seat	Data sheet	Remark no.
White liquor		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	22
	x	x	x	NAF-Duball ball valve full bore	DN25-500/1"-20"	PN10-40	200	EN 1.4408	EN 1.4408	PTFE*	Fk 41.61	22
White water		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408 HCr	Alloy 6	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
White water, acid		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	15
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	15
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
White water, alkaline/neutr.		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	
White water, chloride stage		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	7
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	7
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	7
White water, chlorine dioxide		x	x	NAF-Setball ball sector valve	DN25-500/1"-20"	PN10-40	250	EN 1.4408	EN 1.4408	PTFE*	Fk 41.51	7
	x	x	x	NAF-Torex butterfly valve	DN80-700/3"-28"	PN10-40	350	EN 1.4408	EN 1.4408	Inconel	Fk 41.42	7
	x	x		NAF-Triball ball valve	DN 10-100	PN10-40	250	EN 1.4408	EN 1.4435	PTFE*	Fk 25.622	7

M = Manual valve   O = On/Off valve   C = Control valve

*) When impurites, incrusts or adhesive stuff occur use metal seat Alloy 6/Inconel).This also applies for control with a dp of 1 bar or more.

General Valve Selection Guide
P&P Applications

Remarks

Remark

1. Stainless steel valve with PTFE seats are recommended. NAF ball sector valve and butterfly valve with O-ring stem seal can be delivered in a speciel vacuum design.
2. Select valve in stainless steel in order to prevent impurities by rust.
3. Glue can in cold and undiluted condition need steam jacketed valve.
4. Peroxide is slowly disintegrated into water and oxygen in contact with stainless steel. This process gives an increase in volume and cavities must therefore be avoided. Ball valve must have a cavity relief - a hole drilled in the up stream part of the ball. The valve shall be degreased.
5. For very erosive service (> 30% Lime mud) select NAF-Duball with ceramic inserts or with Alloy 6 in/outlet.

6a. Butterfly valve can be used for screened pulp up to a consistency of 3%.

6b. Use seat rings in Alloy 6 for unscreened pulp containing impurities.

7. For pulp and white water containing chlorine or chloride dioxide the pH-value can vary. With a pH over 3 valve made of stainless steel A351 CG8M can be used and with a pH over 5 valve in stainless steel EN 1.4408 (CF8M) can be used. O-rings in FPM are recommended. Ball sector valve and butterfly valve for pump control, use valve with metal-o-plastic bearings.
8. Up to a consistency of 5% valve with seat rings in PTFE will work. Above 5% seat rings in Alloy 6 are recommended.
10. For sulphuric acid with a consistency of more than 96% and a temperature of max. 40 °C/104 °F valve in stainless steel EN 1.4408 (CF8M) can be used. valve made of stainless steel type Alloy 20, Sandvik 2RK65 or 904L, can be used for all concentrations but with a limitation regarding the temperature.
11. Steam jacketed valve are normally needed for wax.
12. Ground wood pulp may have long fibres. For paper machine applications full bore valve or polished butterfly valve may be used.
13. valve to be used for oxygen and ozon service must be cleaned and degreased. High velocity during a long period must be avoided. Carbon steel valve may be used but as rust is difficult to avoid after degreasing stainless steel valve are mostly preferred.
14. Dry chlorine gas with a maximum water content of 150 ppm (150 mg per kg chlorine).
15. valve with O-ring stem seal should have O-rings of FPM, when the pH is less than 2.
16. The valve recommended can be used only if there is no air in the flow.
18. valve made of stainless steel EN 1.4408 (CF8M) and with Alloy 6 seat rings may normally be used for sulphite cooking liquor but if there is Cl2 and/or SO3 in the liquor more corrosion resistant materials should be used. If the chloride content is more than 150 ppm ball valve with ball and seat rings in Alloy 6 should be used. For higher contents than 400-500 ppm use Hastelloy C. If there is risk for hard deposit (incrustings) use Alloy 6 ball. The actuator should be chosen with a 50% margin of torque due to risk for incrustings.
19. For sodium bisulphate with a consistency of more than 10%, stainless steel with a higher corrosion resistance than EN 1.4408 (CF8M) should be used. If some corrosion is acceptable, a ball valve in A351 CF8M with a ball in Hastelloy C may be used.
20. Aluminium chloride is highly corrosive in all concentrations and valve in Hastelloy C or PTFE lined valve are recommended.
22. valve with seat rings in PTFE can normally be used for white liquor, but if there is still calcium carbonate in the liquor, valve with Alloy 6d seat rings are recommended.
23. Sulphate cooking liquor is a mixture of white liquor and weak liquor. Full bore ball valve with Alloy 6d seat rings are normally used. A Alloy 6 ball is also preferred. If ball valve with seat rings of PTFE are used, the seat rings must be of encapsulated design. Close to the digester only ball valve with Alloy 6d seat rings may be chosen.
24. Lime sludge mainly contains calcium carbonate but also alcalines and calcium hydroxide. Ball sector valve with seat rings in Alloy 6 may be used.
25. For Black liquor >60%, locked seat rings could be required, or NAF design "T" with double O-rings which seal-off the area behind the seat rings .
26. At pipe cleaning with acid do not use chrome plated parts. For ball valves, balls of Alloy 6 to be used.

Remarks

Remark

27. valve in EN 1.4408 (CF8M) can be used if the consistency is maximum 25% at a temperature of maximum 100 °C/212 °F and maximum 50% at maximum 20 °C/68 °F.
28. For chlorine water with maximum 1 mg/l and a temperature of maximum 20 °C/68 °F valve of stainless steel EN 1.4408 (CF8M) can be used. For higher concentrations and temperatures PTFE-lined valve must be chosen.
29. For dry chlorine dioxide gas stainless steel can be used but the stem sealing should be of O-ring type. A leaking stuffing box is dangerous!
32. The media is not corrosive but in order to prevent impurities by rust stainless steel valve are often preferred.
36. For clean condensate ball sector or ball valve with seat rings in PTFE can be used. Temperature limits according to data sheet. If the condensate contains hard deposits valve with Alloy 6 seat rings should be used.
39. If the temperature is below 50 °C/122 °F and the pH is over 2, EPDM can be used. If the pH is less than 2, O-rings of FPM can generally be used.
40. In most salt solutions (except chlorides) O-rings of EPDM can be used.
43. Chromeplated ball should not be used. For liquid ammonia (below -35 °C/-31 °F) impact tests are often required.
44. O-rings must be of FPM.
45. For turpentine and condensate or steam containing turpentine must have valve with O-rings of FPM or PFM. For condensate/cooking liquor steam, use PFM.
46. For sodium hypochlorite small valve sizes made of Titanium are often chosen.
48. For dried process air valve of stainless steel are recommended. valve for air to empty Cl2, SO2 or H2SO4 systems can be of stainless steel type Alloy 20 or similar.
50. Ball valve with seat rings in Alloy 6 are sometimes preferred for aluminium sulphate.
51. Up to a consistency of 5% ball valve with PTFE seat rings are often used. Above 5% ball valve with seat rings in Alloy 6 are recommended.
52. Barium sulphate often exists as a slurry and ball valve with Alloy 6 seat rings are recommended.
54. For air-free humid sulphur dioxide gas valve in stainless steel Alloy 20 or similar can be used, but if there is any risk for air to be mixed into the gas, valve of Hastelloy C or PTFE-lined valve should be used.
55. Locked seat rings are required, or NAF design "T" with double O-rings which seal-off the area behind the seat rings .
56. NAF design "T" with double O-rings which seal-off the area behind the seat rings is recommended.
57. Only if free Chlor or SO_3 ions not occure in the medium.
58. The stems must be sealed-off from the medium with O-rings. At temperatures above 200 °C special design is required.
59. At temperatures above 100 °C/212 °F and air in the medium, a higher corrosion resistant material is required.
60. At higher pressures is NAF-Trunnball recommended.
61. O-rings must be of EPDM
62. Depending of velocity, temperature ond concentration can chem-nickel or Alloy 21 plated balls be required.

General Valve Selection Guide
P&P Applications

Comments

General	Pressure, temperature, concentration and impurities can change the conditions for the materialselection.
Cleaning medium	Medium used to clean the pipe system could be more aggressive than the process medium. Specially hydrochloric acid should be avoid.
Pulp	Up to a consistency of 1.5 - 2% pulp behaves much like water. At higher consistencies, and especially at pressure drops below 0.8 bar, pulp will decrease the valve capacity. At the same time the installed flow characteristic will be changed in a way that gives a flow maximum at an opening angle of 75 - 80 degrees. In order to avoid problems, the valve must be sized taking these parameters into account. Ballsector valve with Alloy 6 seat could be used up to 16% consistency if dp is above 1 bar. Ball valve are limited to 12%. Recycled fibre stock often contains contaminations - clay, chalk and other additives which cause wear when the flow velocity is high, tape, foil, polyethylene and other stringy objects causing plugging or jamming of valve while starting to wind up in flow orifice, bailing wire, grit, staples and pins wear out valve seats and causing leakage. Select valve with full bore and seats in Alloy 6 for these conditions. The noise level for pulp applications is normally 3-5 dB(A) lower than for water at the same conditions.
Control accuracy	Vid vissa applikationer kan kravet på regleringen vara lägre varvid NAF-Triball kulventil med stellit säte kan användas. For some applications is the demand on the control accuracy lower. NAF-Triball ball valve with Alloy 6 seat can be used in these cases.
Noise and cavitation	For these applications we recommend low-noise valve as NAF-Trimball or NAF-Setball with Z-trim. Data sheet Fk 41.65 and 41.53.

Rubber materials (Elastomers) and PTFE as seals in valves.

In NAF´s butterfly-, ball- and ballsector valves are the elastomers EPDM and FPM used as stem sealings (O-rings) and in butterflies also as seat seals.
PTFE is used in butterfly-, ball- and ballsector valves as stemsealings (boxpackings) and as seat seals.

Elastomers

EPDM and FPM have corresponding and very good sealing qualities.
EPDM has in some ways better resistance against wear and yielding.

1. EPDM is selected before FPM in the following medium:
   - Air and neutral gases (with no oil)
   - Water and drain (with no oil)
   - White water, condensate and pulp with pH above 2 and not including terpenes or mercaptanes.
   - Inorganic acids if pH is above 2
   - Alkalics (with no terpenes)
   - Organic aerations as follows:
     Ketones (acetone), amines, ammonium, low molecular esters, silicone oils, silicone fats, phosphate based hydraulic- and lubrication oil, ethylene glycol water mixture.

2. FPM is selected before EPDM in the following medium:
   - Air and neutral gases (with oil)
   - Water and drain (with oil)
   - White water, condensate and pulp with pH below 2
   - Alkalics with terpenes if pH is below 10. If pH is above 10 use PFM (Isolast) in the O-rings.
   - Chlorine aerations
   - Organic aerations as follows:
     Vegetable oil, mineral oil, petroleum hydrocarbure (fuel oils, ligroin, photogen, petrol, benzene, xylene, toluole), chlorided hydrocarbures (tri-and perchloroethylene)

3. For other medium can normally EPDM be used.

PTFE

PTFE is a very useful material, it is however not suitable for fluorine, hydrofluoric acid or oxygen above 60 °C.
For very oxidating medium should carbon filled PTFE not be used. Pure or modified (TFM 1600) PTFE should be used.
As seat seal limited use if the medium contains impurites, incrusts or adhesive stuff. Use metal seat (stellite/Inconel) in these cases. This also applies for control with a dp of 1 bar or more.