

 ALFA-LAVAL

THE ALFA-LAVAL DECANTER CENTRIFUGE

- a workhorse for separation duties



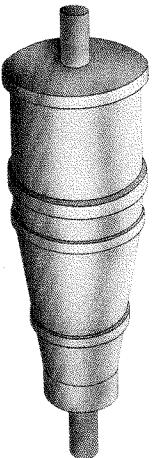
A CORNERSTONE IN THE ALFA-LAVAL

The Alfa-Laval Separation Engineering Division is one of the world's leading manufacturers of equipment for mechanical separation of liquid-liquid, liquid-solid and liquid-liquid-solid mixtures. Its products include sedimenting centrifuges as well as various types of filters – a comprehensive range in which the optimum equipment for most industrial separation duties can be found. The decanter centrifuge is one of the cornerstones of the Alfa-Laval range, alongside disk stack centrifugal separators.

Alfa-Laval has been manufacturing decanters since the early fifties. An active development program has improved the basic design and led to the production of new types suitable for a large number of separation duties.

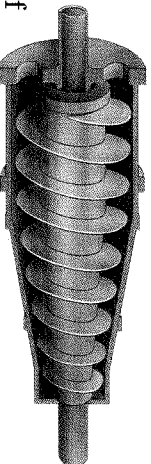
WHAT IS A DECANter CENTRIFUGE?
The decanter belongs to the cate-

gory of sedimenting centrifuges. Essentially, it is a settling tank wrapped around an axis and spun



Centrifugal sedimentation

at high speed to subject the contents to a centrifugal acceleration equal to thousands of gravities. The distinguishing characteristic of the decanter compared to other sedimenting centrifuges is



Continuous discharge

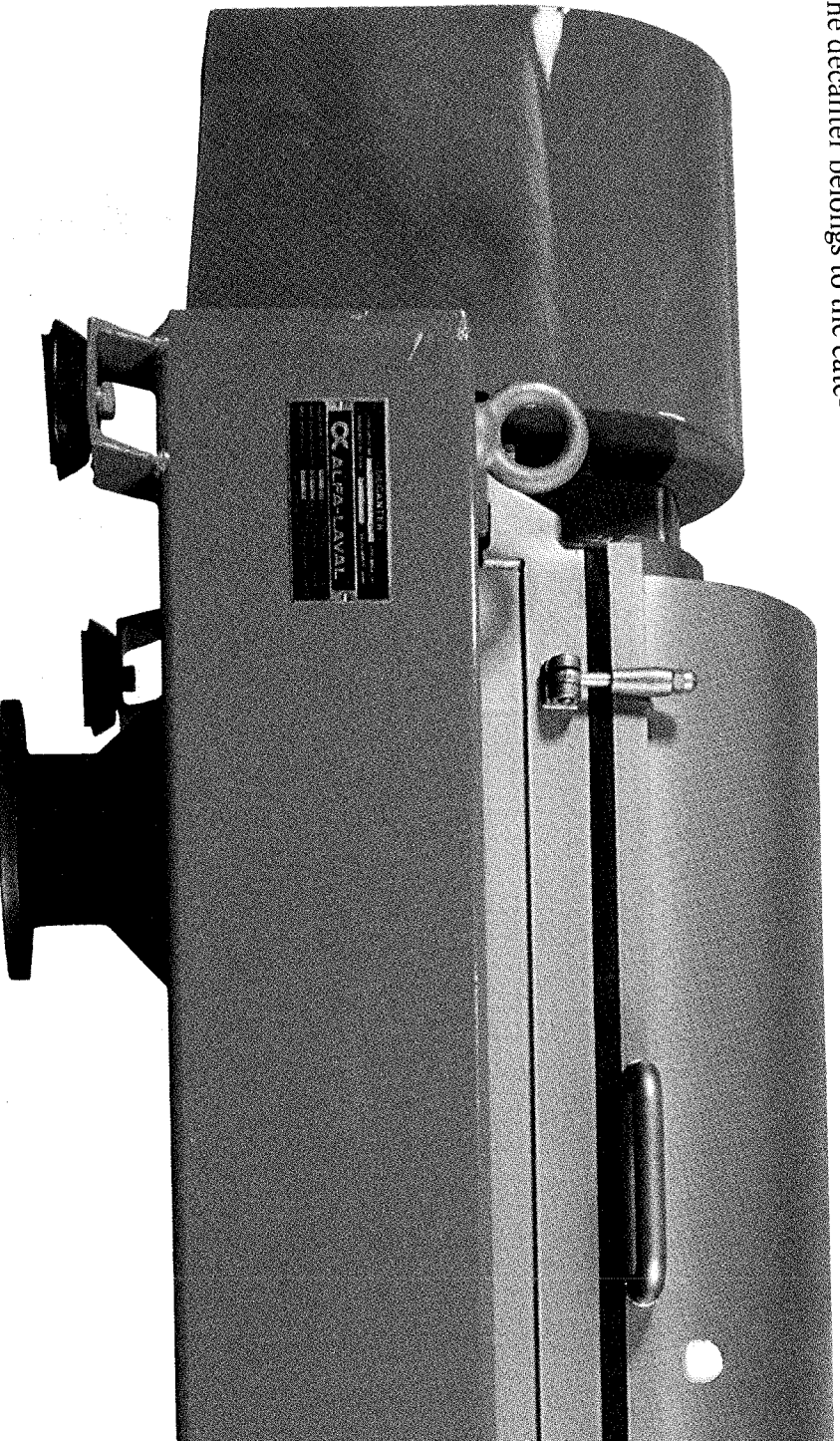
the axial screw conveyor (scroll) used for discharge of the sediment. This makes separation in the decanter a fully continuous operation.

WHAT CAN A DECANter CENTRIFUGE DO?

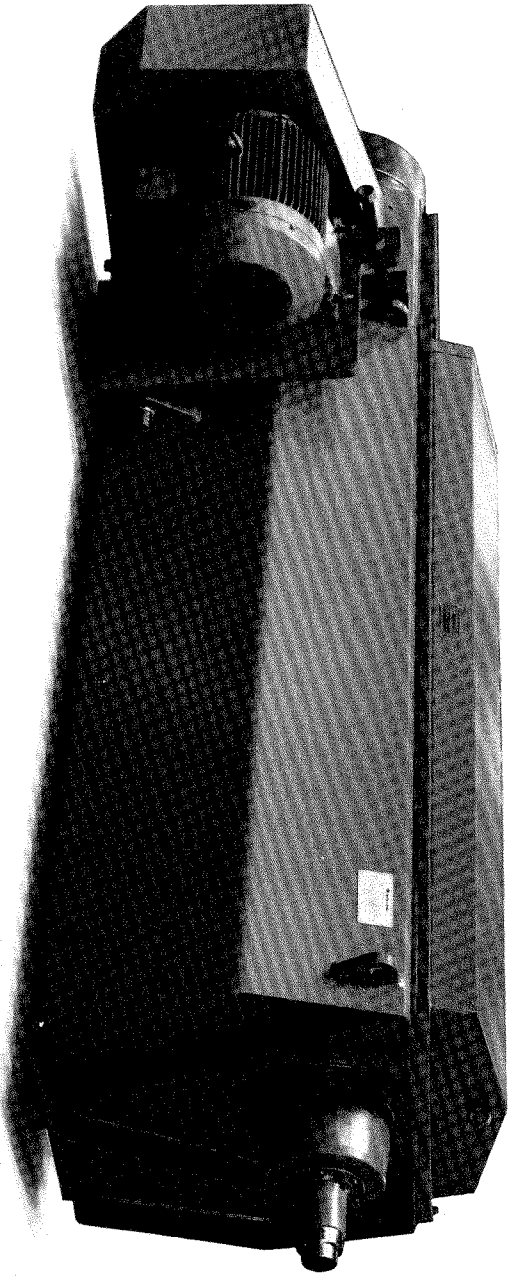
The decanter is primarily designed for separation of slurries into one or two liquid phases and a solid phase. Decanters can handle feeds containing up to about 65% suspended solids by volume, in particle sizes from a few microns up to about 20 millimetres.

Decanters are used today in the following main fields of application:

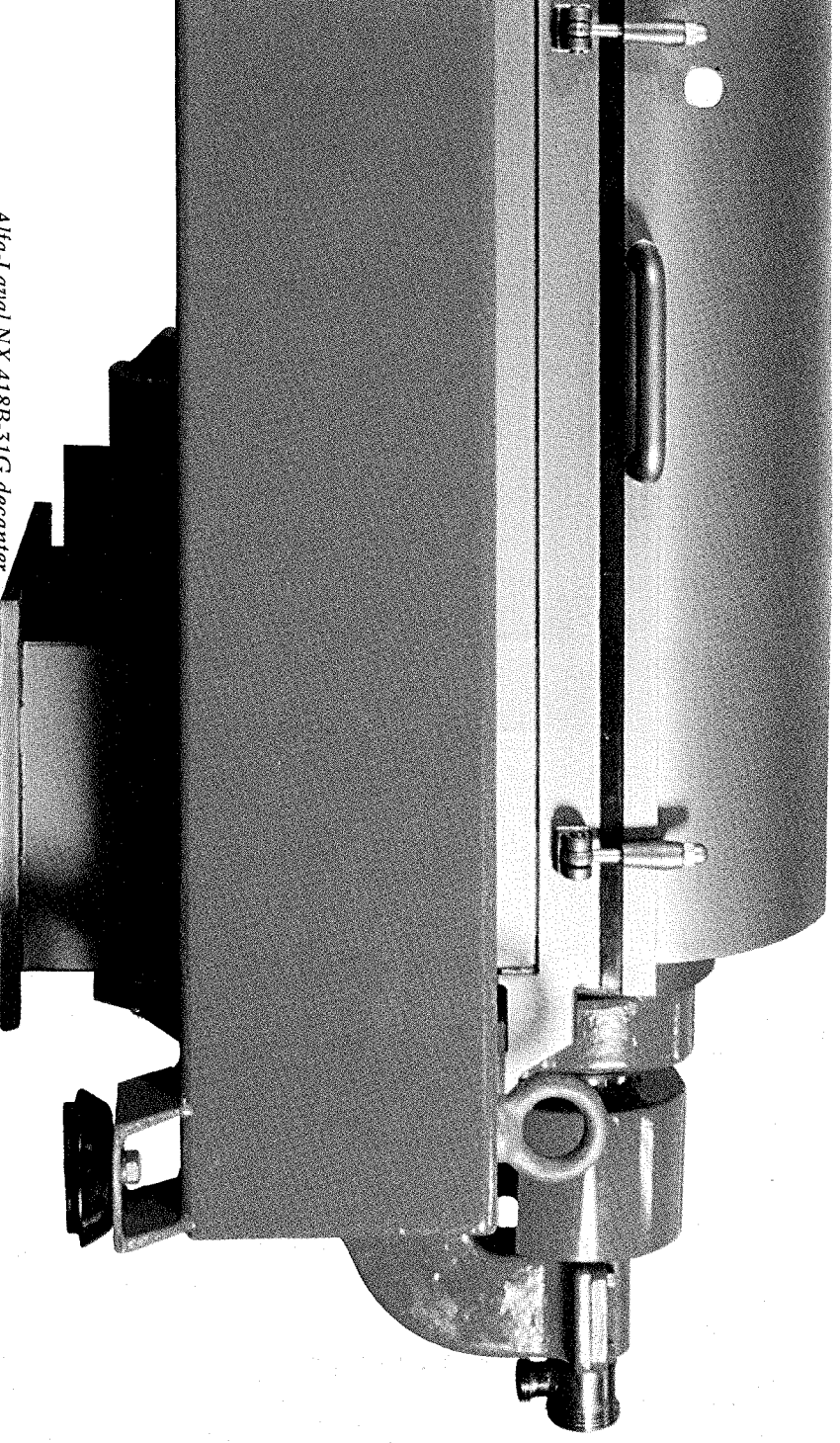
- Chemical and allied industries
- Food processing
- Pollution control (sewage sludge dewatering and industrial effluent treatment).



RANGE OF SEPARATION EQUIPMENT



NX 329 decanter. Note the design of the housing, which reduces noise to a very low level.



Alfa-Laval NX 418B-31G decanter.

HOW A DECANTER

CONSTRUCTION

Separation takes place in a cono-cylindrical drum, also called the bowl.

This is driven by a belt transmission from a side mounted or flanged electric motor. Maximum bowl speed for the NX 418 illustrated below is 4000 rpm, generating a centrifugal force of 3100 G at the bowl wall. The liquid level inside the bowl (pond depth) is determined by the setting of overflow weirs at the wide end.

The feed pipe projects into the hollow body of the scroll (screw conveyor), which rotates in the same direction as the bowl but at a slightly different speed, pushing settled solids towards the discharge

openings at the tapered end. To prevent the contents of the bowl from slipping due to the action of the scroll, the inside of the bowl wall is provided with axial ribs or grooves.

The gearbox causes the scroll to rotate relative to the bowl. The relative speed can be varied if the gearbox is provided with a separate sunwheel drive.

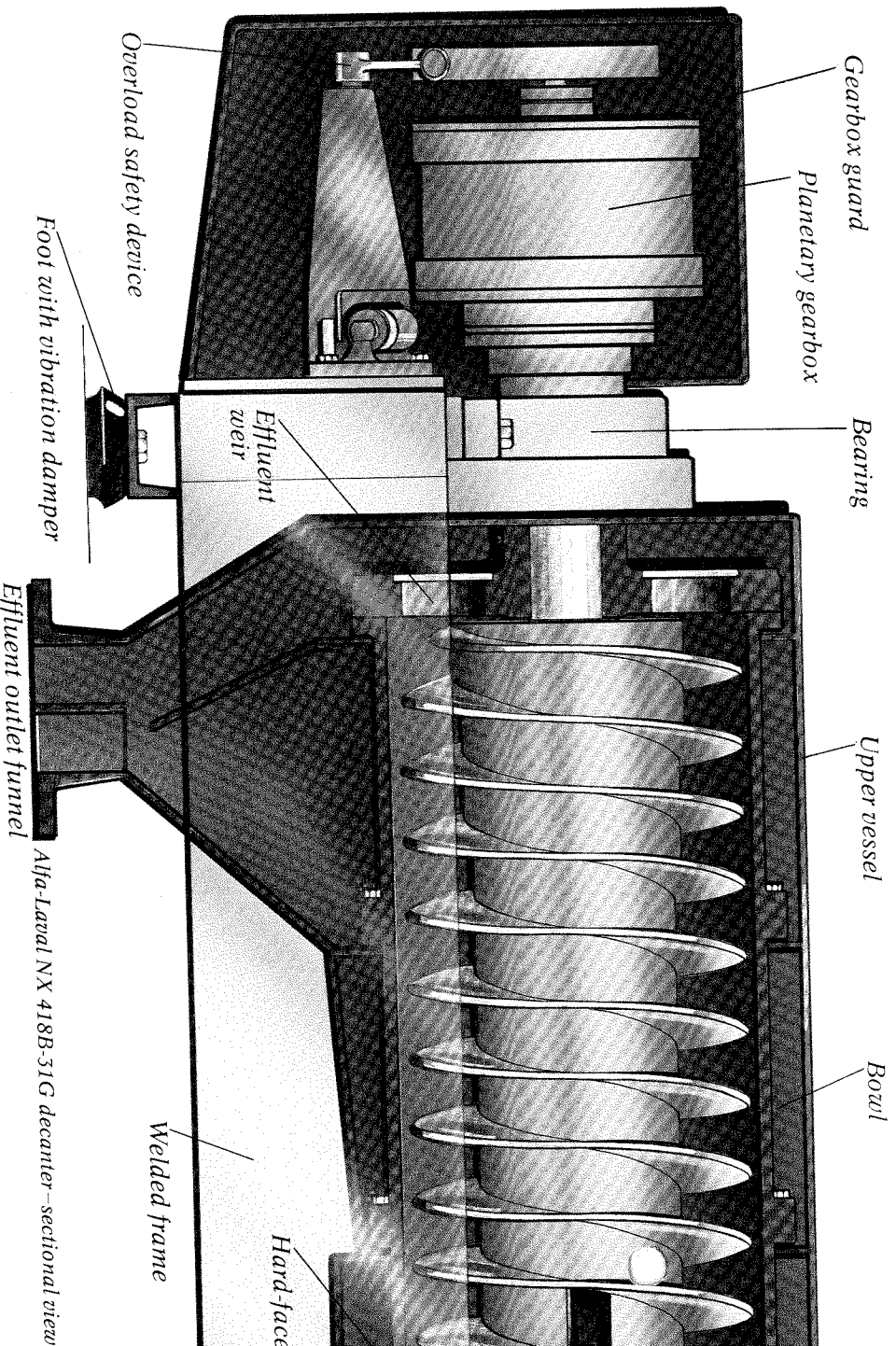
The semicylindrical upper vessel shields the moving parts. Interior baffles fit closely around the bowl to form collecting compartments for the separated phases. The lower vessel is shaped into discharge funnels. The shaft openings at each end of the vessel can be fitted with gastight seals.

FEED AND DISCHARGE

The figure on the right illustrates the continuous separation process in the decanter bowl. The feed is introduced into the conveyor body and passes out into the interior of the bowl.

Clarification takes place in the cylindrical "pond". The denser solids settle to the wall, and clear liquid overflows continuously from the discharge weirs at the wide end.

Dewatering takes place when the solids are compressed under centrifugal force. As the solids are conveyed up the dry "beach" by the scroll, surplus liquid drains back into the pond.

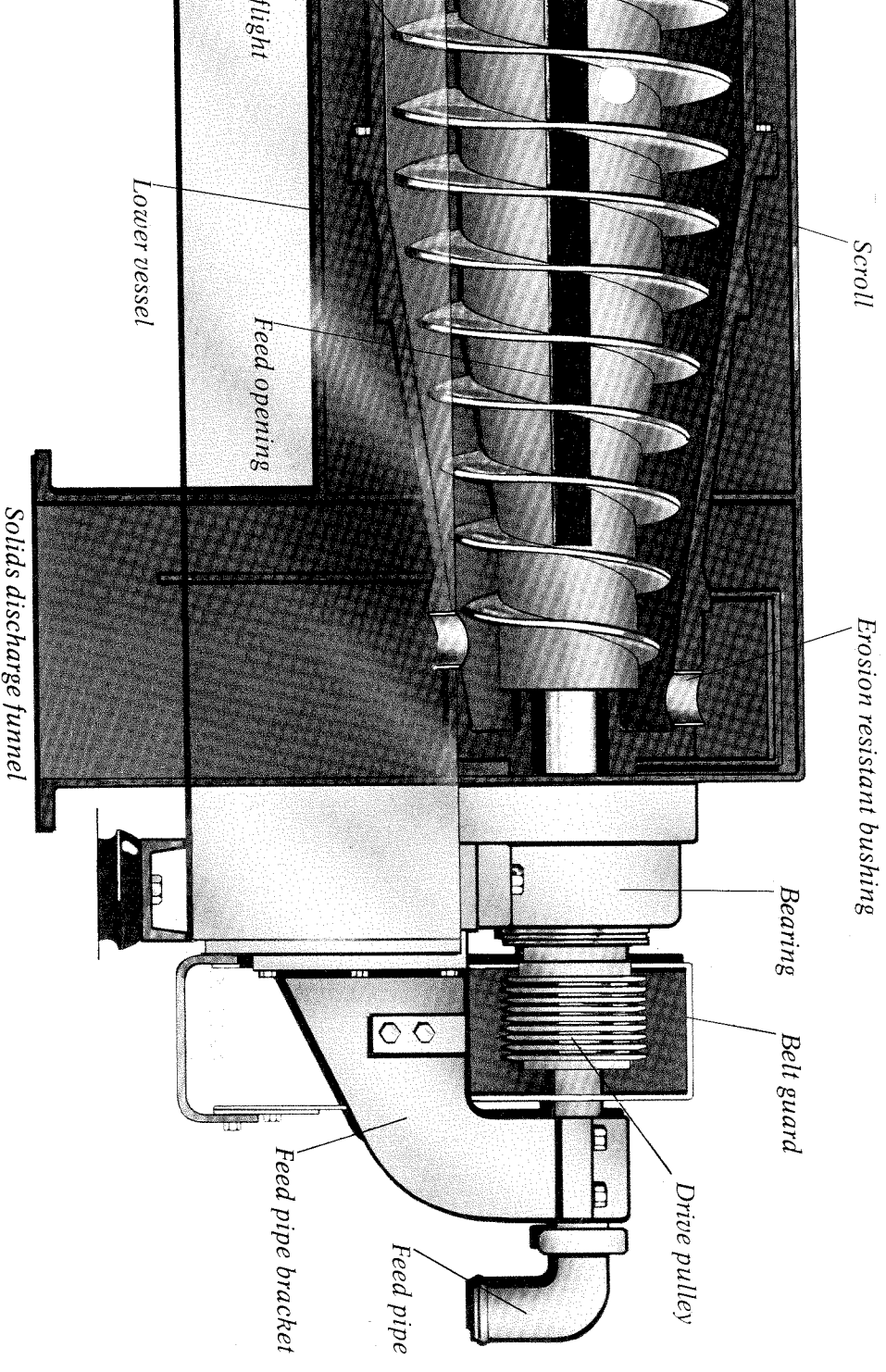
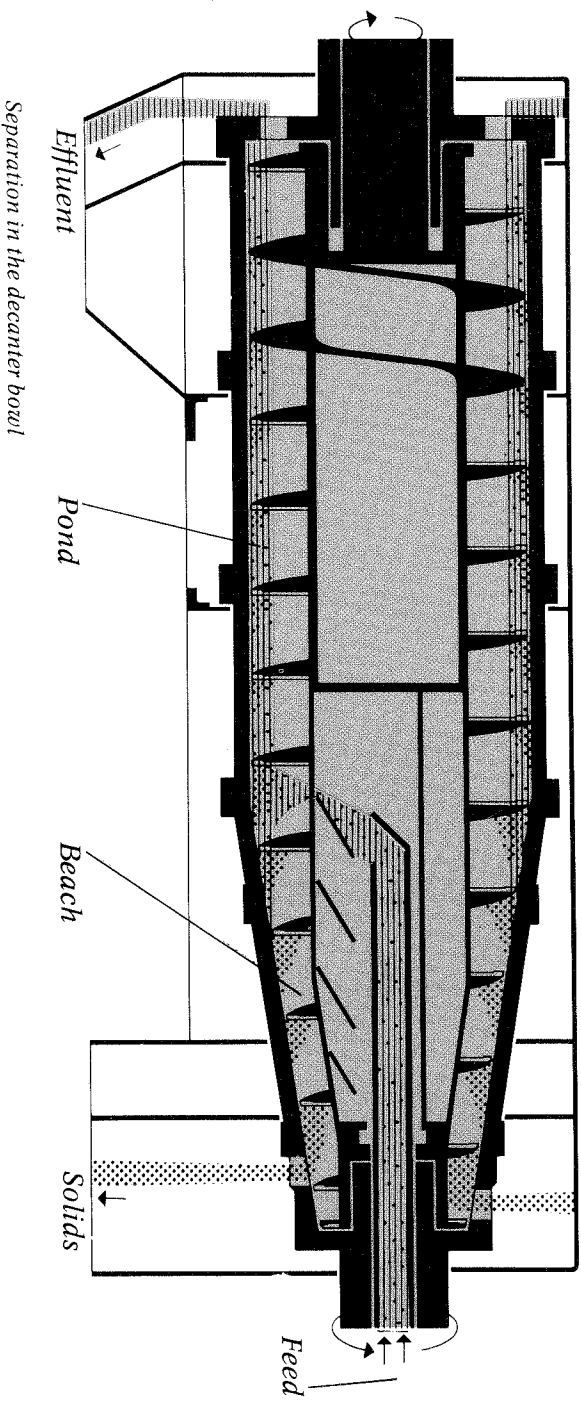


Foot with vibration damper

Effluent outlet funnel

Alfa-Laval NX 418B-51G decanter—sectional view

CENTRIFUGE WORKS



WHY A DECANTER?

CENTRIFUGAL SEDIMENTATION

In principle there are two ways to separate a suspension of solid particles from a liquid:

1. Sedimentation.
2. Filtration.

Gravity sedimentation is cumbersome and slow, but *centrifugal* sedimentation is practically instantaneous. Accelerations of thousands of gravities and short settling distances make the process very efficient.

CENTRIFUGAL EQUIPMENT

There are two main classes of sedimenting centrifuges – the high-speed, disk stack separator and the decanter. Alfa-Laval manufactures both. The graph below shows their respective

capabilities in terms of separable particle size and concentration.

Both types operate continuously, and both are equipped for automatic desludging. Both are also capable of performing three-way separation on mixtures of a solid phase and two liquid phases.

THE VERSATILE DECANTER

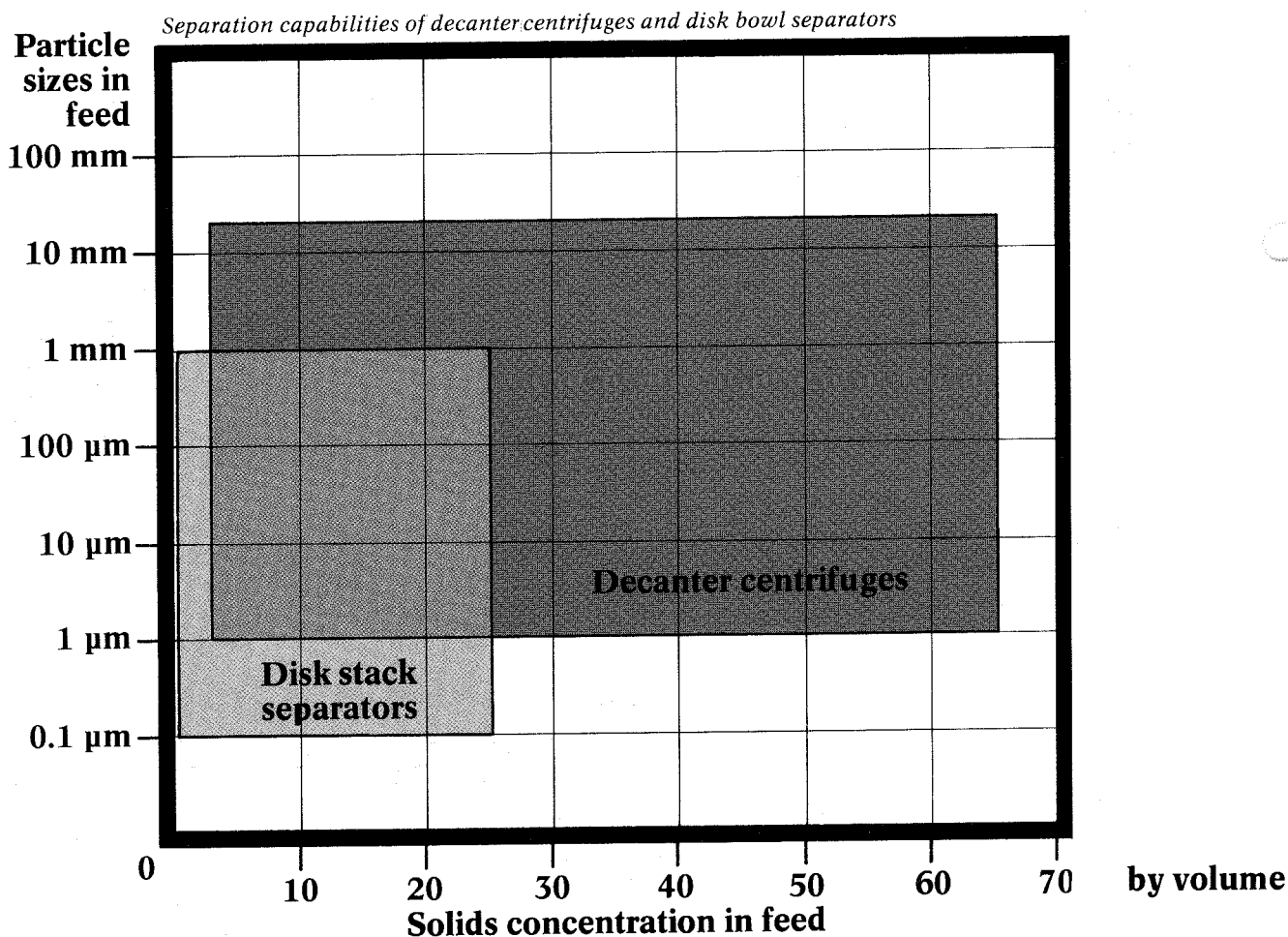
The area shown for the decanter in the graph covers a vast number of practical separation duties in industry.

The versatility of the decanter applies not only to the types of suspensions it treats, but also to the way this is done. Alternative components and configuration can be chosen to optimize performance according to the purpose of the operation, e.g.

1. *Clarification*, i.e. maximum removal of solids from the liquid (also applicable where the aim is a high yield of solids);
2. *Concentration*, i.e. maximum removal of liquid from solids;
3. *Classification* of solid particles into coarse and fine fractions.

UNBIASED RECOMMENDATION

Alfa-Laval manufactures many different types of separation equipment, so for any given duty we can recommend the best and most economical type on the basis of experience, without prejudice. Decanters are often the preferred choice because they can offer fully continuous operation, high reliability, high process compatibility and low labour demand.



AN ECONOMICAL CHOICE

A decanter centrifuge is a precision built machine. When operated under acceptable conditions, a working lifetime of 20 years or more can be achieved. The combination of small depreciation, efficient performance, low installation cost and low running costs often means that a decanter comes out best from a return on investment analysis.

EASY INSTALLATION

Small size, low weight. A decanter is lighter and more compact than filtration equipment of equal capacity. You save on building space, and you do not have to construct heavy foundations.

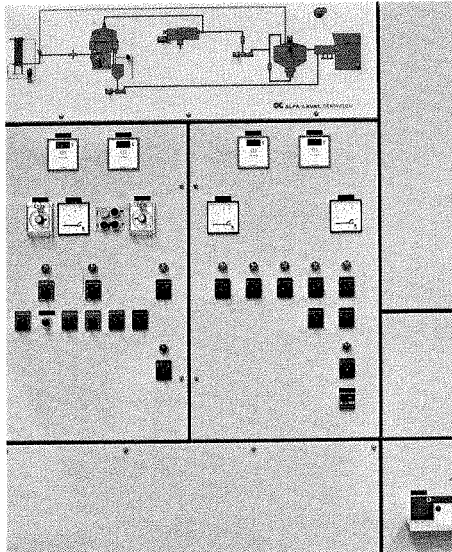
Closed system. Feed and discharge connections are fully enclosed and uncomplicated (also gastight if necessary). No splashing, foaming or fumes.

ECONOMICAL OPERATION

Continuous flow. A decanter discharges both separated phases continuously. Production runs do not have to be interrupted for unloading and cleaning.

Sensitive to variations in feed. A decanter can normally be left to run unattended, even where the volume and/or concentration of the feed are apt to fluctuate.

Automation capability. Controls and instrumentation can easily be installed in a central control panel



Control panel for an automated process line including a decanter centrifuge and disk bowl separator.

or other remote location. Decanters are frequently installed as components of fully automated processing lines.

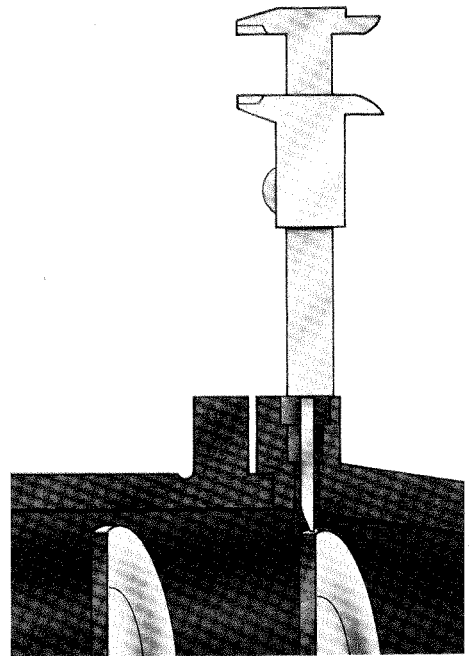
All these characteristics contribute to low labour demand for decanter operation.

No filter aids. Except in special cases – like dewatering of sewage sludge – a decanter operates without additives – a heavy cost item in filtration plants.

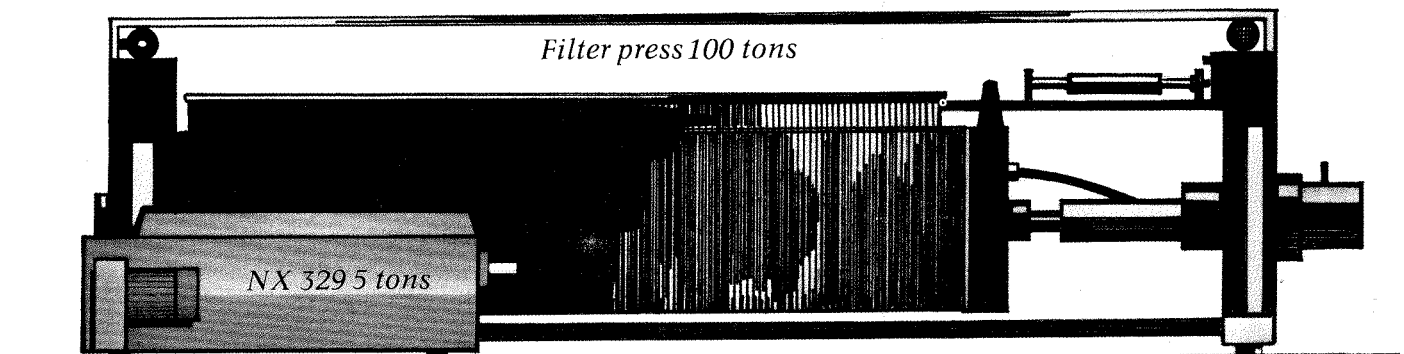
Scheduled maintenance. Certain components of the decanter – especially the scroll – are subject to wear as a result of treating abrasive slurries. But erosion

protection prolongs life between overhauls, and the rate of wear can be measured without dismantling the machine. Component lifetimes can be accurately predicted and overhauls scheduled to suit the owner's convenience. All this results in a very high utilization factor for the decanter.

Exchange scheme. Factory-reconditioned bowls, scrolls and gearboxes are available under an exchange scheme which reduces both cost and delay when essential components need to be replaced.

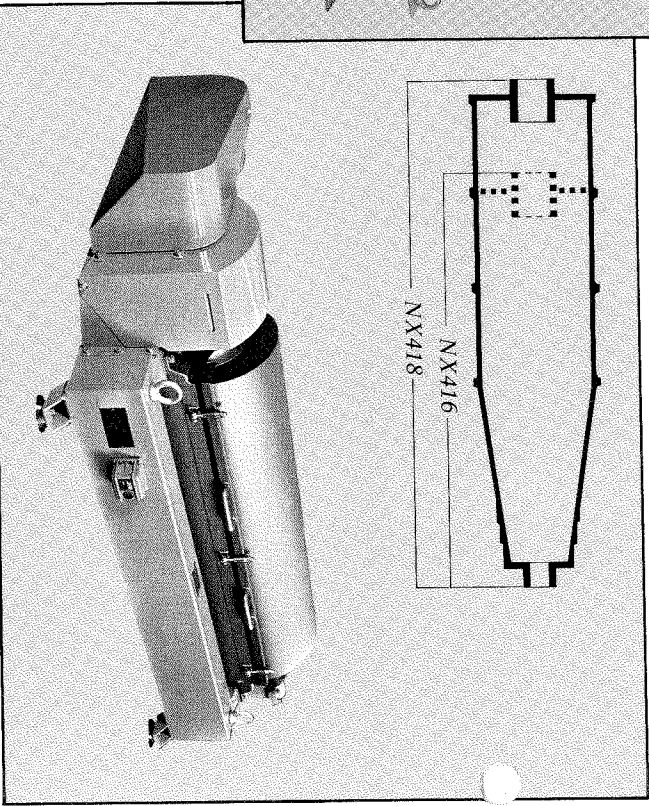
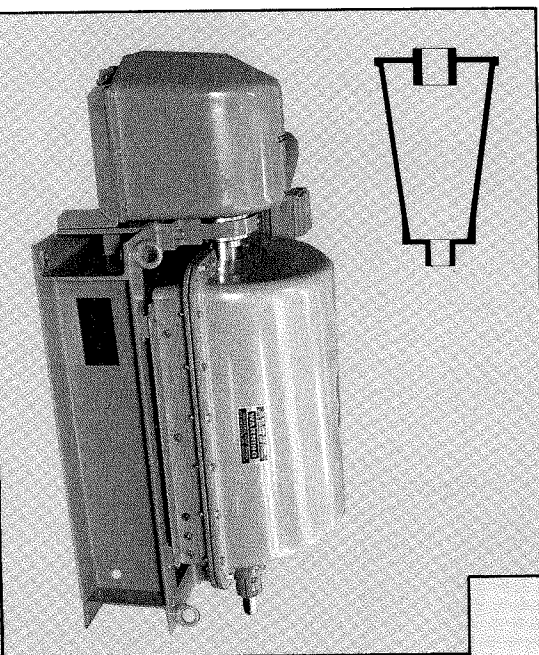
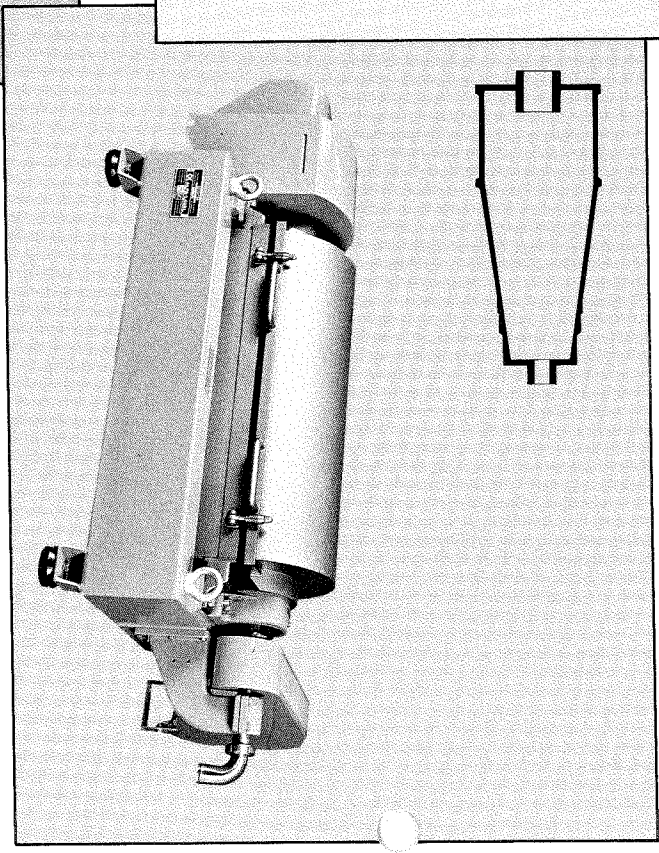
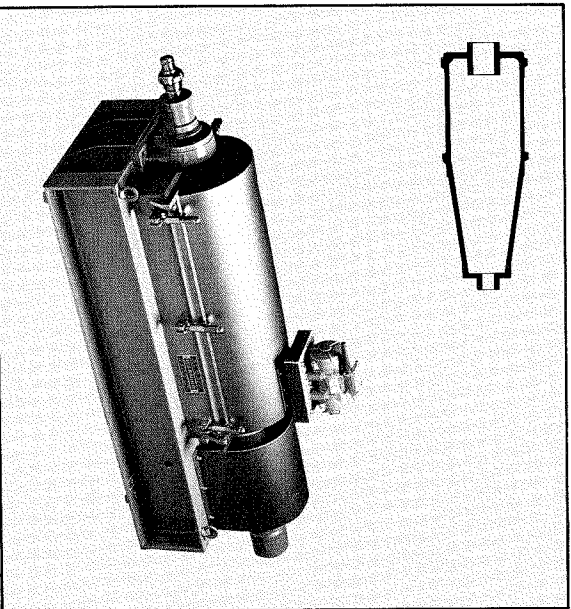


Wear on scroll flights is measured from outside the bowl with a caliper gauge.



Comparative sizes of filter press and decanter installations for dewatering sewage sludge from a town with a population of about 150 000.

THE ALFA-LAVAL RANGE OF



PERFORMANCE

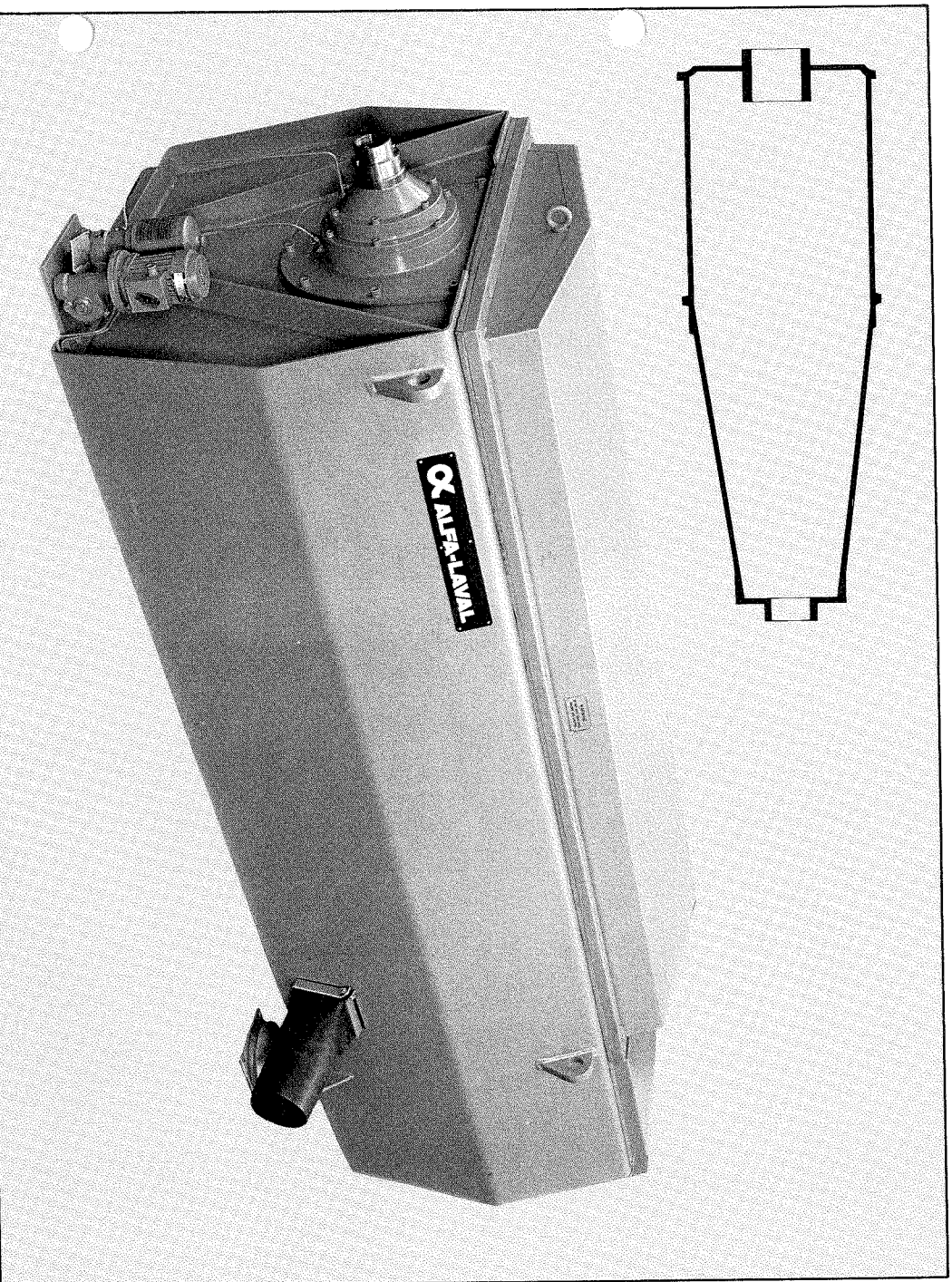
- Max. feed rate (depending on duty) ~50 m³/h
- Max solids discharge ~10 m³/h
- Max. feed concentration ~ 65% DS
- Max. particle size ~ 20 mm

MATERIALS

- AISI 316 and other stainless steels
- Choice of elastomers to suit process requirements
- Special materials on request

(Inset drawings show relative bowl sizes)

DECANTER CENTRIFUGES



NX 329

TECHNICAL DATA

Size	Max. bowl speed r/min	Max. centrifugal acceleration G	Relative separation capacity	Overall installed dimensions			Motor rating kW	Weight without motor kg
				L mm	W mm	H mm		
NX 309	5600	4000	1	2020	850	730	11-15	570
NX 410	2800	1500	0.75-1.5	1460	1030	630	11-15	585
NX 414	4000	3100	1.5-2	2340	1630	690	11-18.5	865
NX 416	4000	3100	2-3	2640	1800	690	15-30	1000
NX 418	4000	3100	3-5	2940	1800	690	18.5-37.5	1200
NX 329	3000	3000	10-15	3420	1985	1310	37.5-90	4200

A RELIABLE

Alfa-Laval decanter centrifuges are built for dependable operation in all sorts of industrial conditions – from chemical and food plants to sewage works and oil drilling platforms.

RUGGED CONSTRUCTION

The bowls are centrifugally cast for safe running at high speed under heavy "gee" loads.

The main components (bowl, scroll and gearbox) are dynamically balanced.

Inlets and outlets are generously dimensioned and designed to prevent clogging. The parts most exposed to contact with abrasive

particles are faced or lined with tungsten carbide alloy.

Bearings are grease lubricated, which means simpler maintenance and better protection of bearing surfaces when the machine is at a standstill.

ACCESSIBILITY

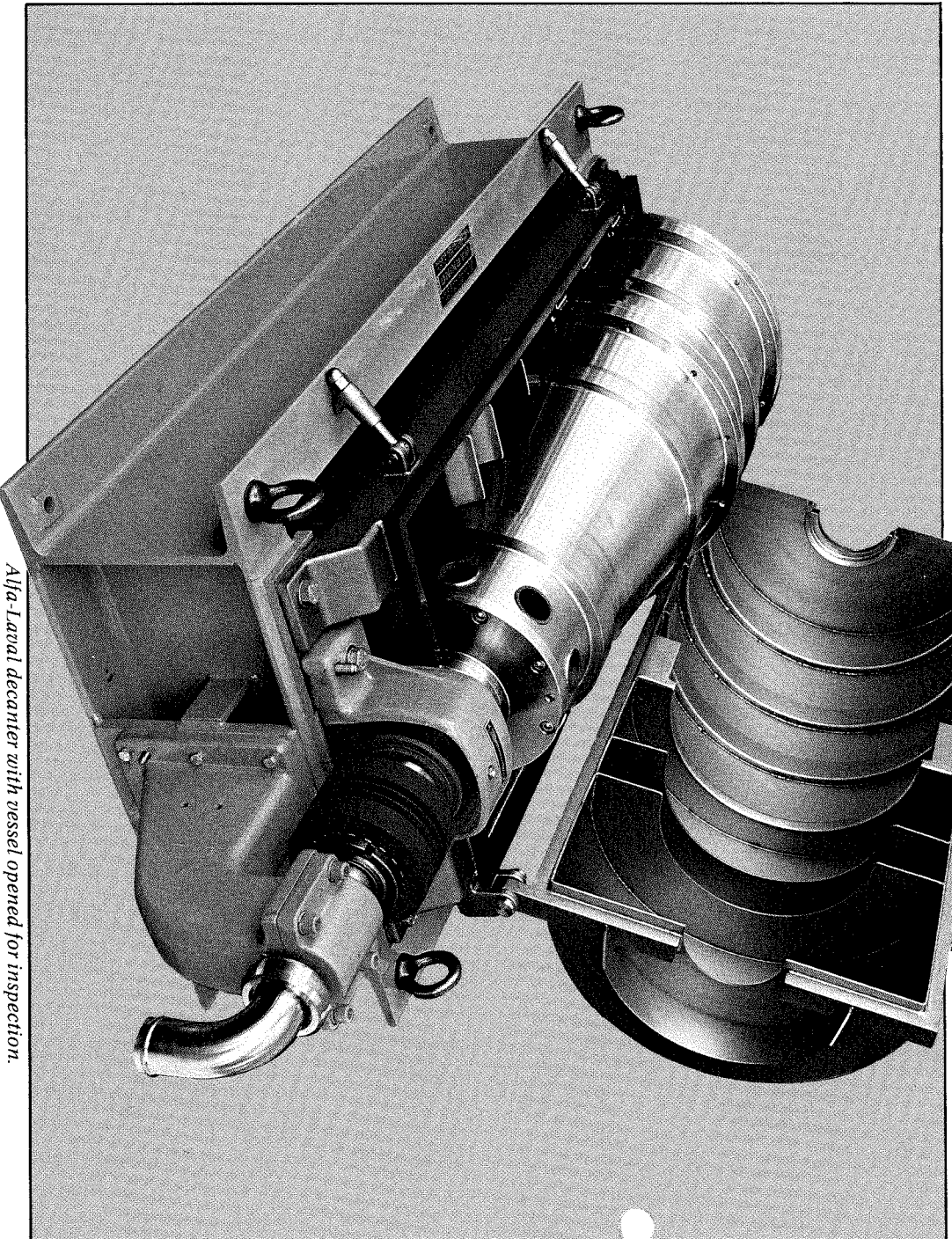
The two-part hinged vessel opens easily to give access to the bowl.

Scroll wear checks and liquid level adjustments can be made without dismantling the bowl or removing it from the vessel.

SAFETY

All moving parts are enclosed by the vessel or protected by guards. Safety devices are available to comply with national regulations, e.g. automatic cutoff of the power supply when the vessel is opened.

Gearboxes disengage automatically if the permitted torque load is exceeded. Even on machines equipped with sunwheel drive, the cutout mechanism can be quickly reset with no need for disassembly or replacement of parts. Remote indication of torque load can be provided, complete with automatic alarms.



Alfa-Laval decanter with vessel opened for inspection.

MACHINE

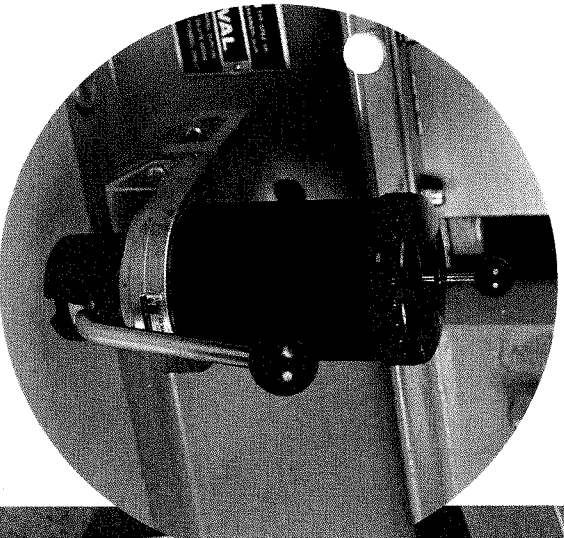
Resilient mounting feet insulate the foundations efficiently from machine vibration. A vibraswitch can be fitted to stop the decanter automatically if vibration tolerance is exceeded.

The closed vessel prevents splashing and escape of liquid. It can also be made gastight to contain fumes.

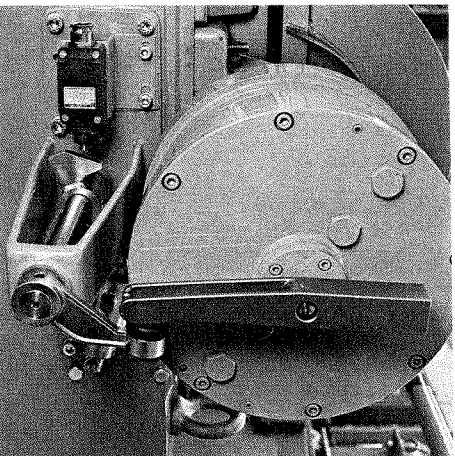
Explosion proof motors can be delivered on request.

PROCESS ADAPTED DESIGN

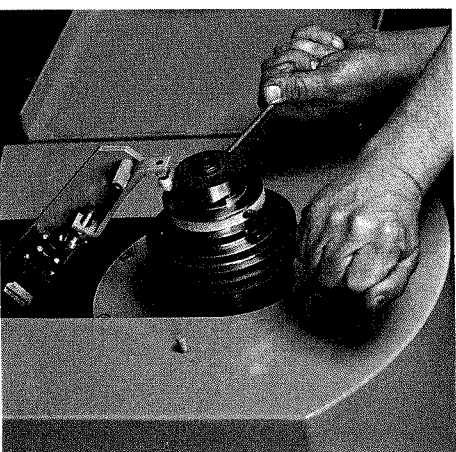
Alfa-Laval's standard decanters (NX series) are versatile enough to cope with a broad spectrum of process specifications. For special requirements, however, Alfa-Laval can also supply alternative components, accessories, and specially modified machines. Some of the standard and optional features that contribute to dependability and versatility are described overleaf.



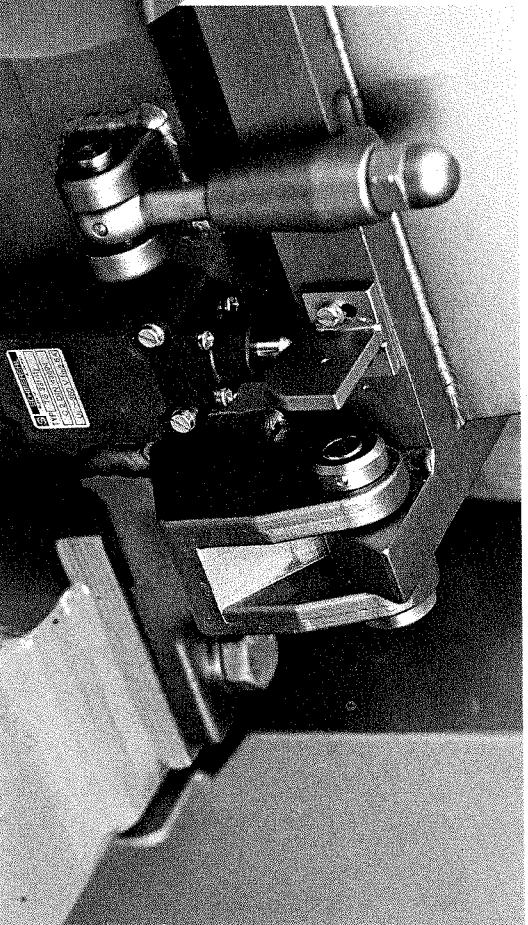
Grease reservoir of central lubrication system, NX 309.



Overload cutoff for gearbox with stationary sunwheel (constant scrolling speed).



Resetting the overload cutoff of a gearbox equipped with sunwheel drive.



Power cutoff switch operated by opening of the vessel.

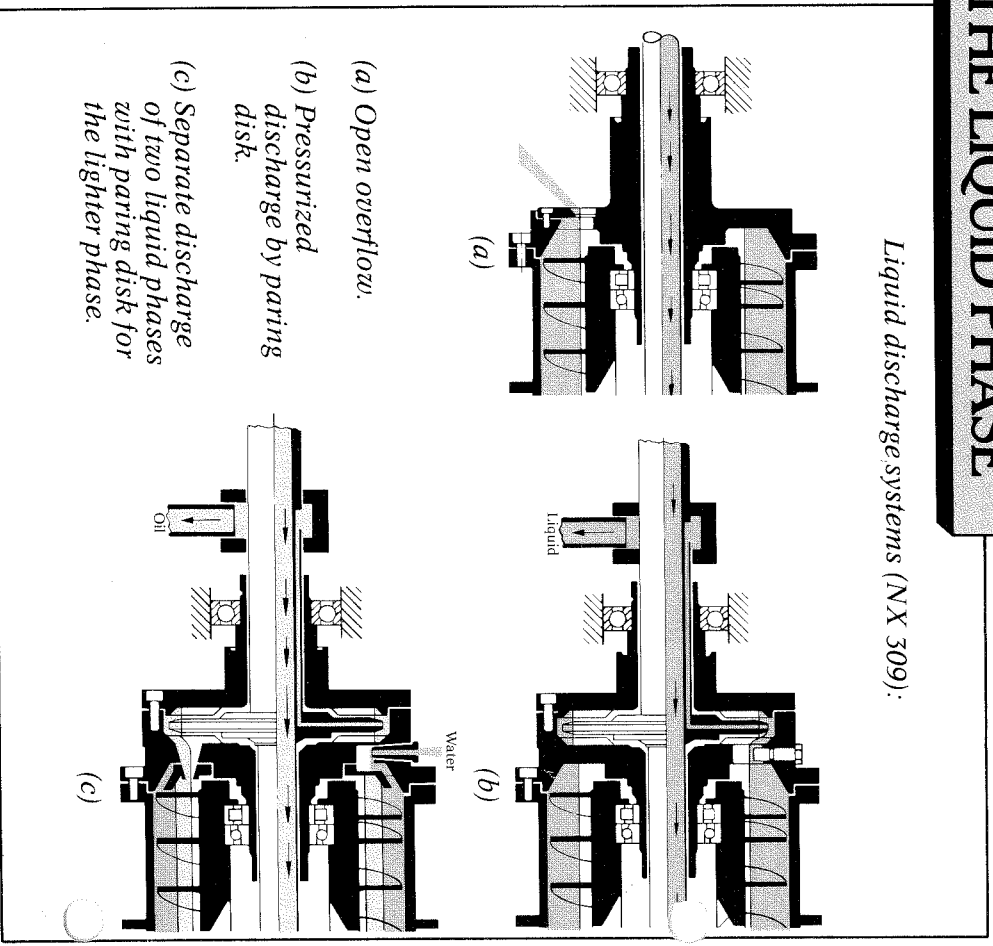


Detail of frame with vibration damping pad and vibraswitch.

HOW ALFA-LAVAL DECANTE

THE LIQUID PHASE

Liquid discharge systems (NX 309):



Alfa-Laval decanters can cope with difficult liquids and solids, and meet a wide variety of special process requirements. Here are some examples.

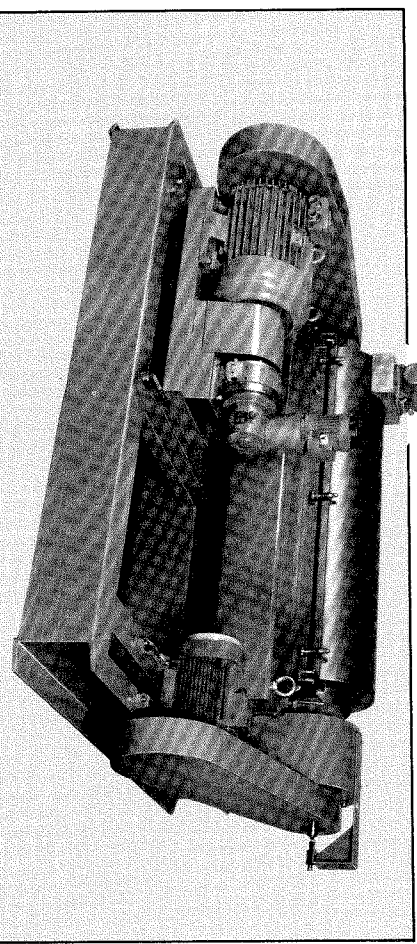
Aggressive liquids. Standard material for wetted parts is acid-proof stainless steel. Specially resistant materials can be specified. Various gasket and seal materials are available to match process requirements.

Fuming and volatile liquids. The feed pipe and the shaft openings in the vessel can be fitted with gashight seals.

Foaming and oxidation-sensitive liquids. Where it is desired to avoid air pickup, the decanter can be equipped with a paring disk. This is a stationary pump impeller that utilizes the energy of rotation of the liquid to discharge it under pressure to a closed pipeline.

Two liquid phases. Special decanters are available for three-way separation of liquid-liquid-solid mixtures. Outlets at two different (adjustable) radial levels discharge the two liquid phases separately.

CLEANING IN PLACE



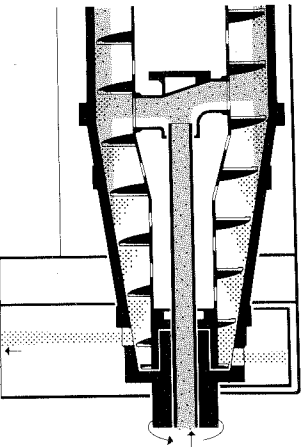
NX 418 decanter equipped for CIP.

- Special models have been developed for sanitary and other applications requiring cleaning in place (CIP) capability. Design features include
- built-in spray nozzles to wash the outside of the bowl and the inside of the vessel;
 - a special low-speed, intermittently reversing motor to generate a "washing machine" effect during the CIP cycle.

RS HANDLE YOUR PRODUCT

THE SOLID PHASE

Chokeproof inlets. The standard inlet to the smooth polished hollow axis of the scroll body handles most types of slurry without risk of choking. A special inlet with erosion protected distributor is available for certain duties such as sewage sludge dewatering.



Special inlet with feed distributor.

Erosive particles. The tips and leading flanks of the scroll flights are hardfaced with tungsten carbide alloy. The solids outlet openings are lined with hard metal or ceramic bushings. Longitudinal

strips welded to the inside of the bowl wall retain a thin layer of sediment that acts as an abrasion shield. Extra heavy duty erosion protection can be provided on request.

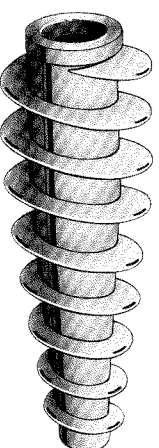
High friction solids which place a heavy torque load on the gearbox can be dealt with in various ways, e.g.

- a special high torque gearbox;
- a scroll with forward tilted and/or polished flights;
- a high relative scroll speed.

Low friction solids that tend to slide back into the pond can be discharged more effectively by a fine pitched scroll.

Sticky solids. The scroll can effectively unload even sticky solids. Adhesion to the inside of the vessel can be prevented by fitting a vibrator or scraper.

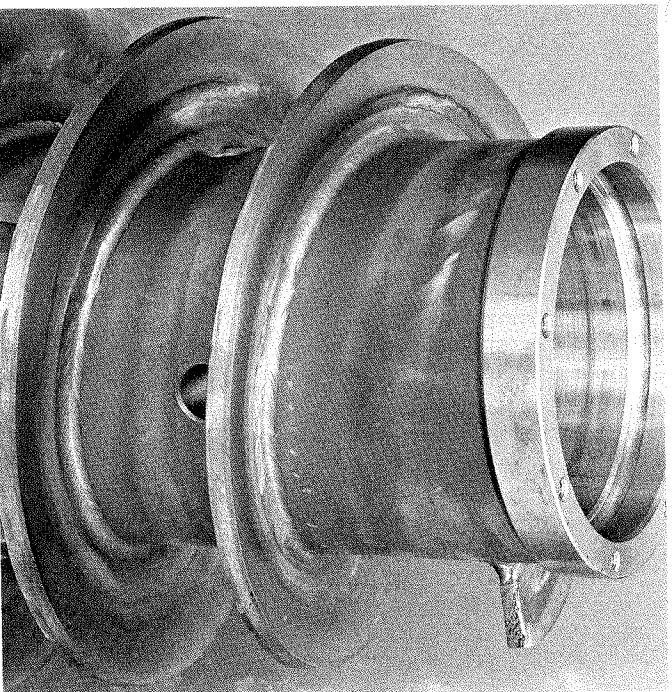
Solids that need washing. Wash water can be supplied to the beach zone inside the bowl by a double feed pipe.



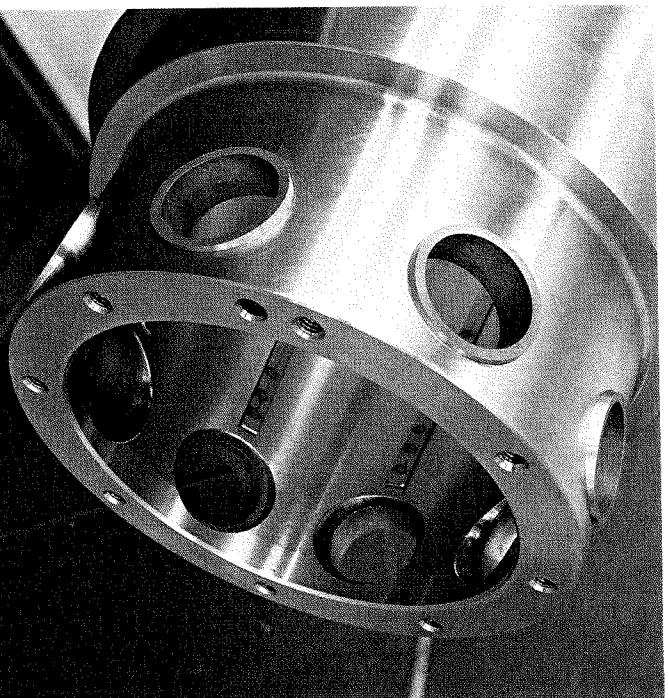
Coarse and fine pitched scrolls

Restriking of solids after separation. A special cyclone can be mounted inside the vessel for effective mixing of the separated solids with a liquid.

Very fine particles can be aggregated into larger and more readily separable flocs by adding polymers to the feed. A distributor-type inlet should be used in such cases, because it gives a smoother angular acceleration with less risk of shattering the flocs.



Hardfaced scroll flights.



Solids discharge end of a decanter bowl. Note welded strips and erosion resistant bushings.

HOW TO GET THE BEST

IT PAYS TO INSIST ON PERFECTION

Careful equipment selection can pay big dividends. If a special machine or accessory can squeeze even one more percentage unit of yield out of your process, or add just a few hours a month to the availability of your plant, the investment is well worth while.

Helping you specify the right machine with the right equipment is all part of Alfa-Laval's delivery service. But optimization does not end there. Alfa-Laval decanters offer a number of possibilities for adjustment of operating data to get the very best results. This is what we call tuning the decanter.

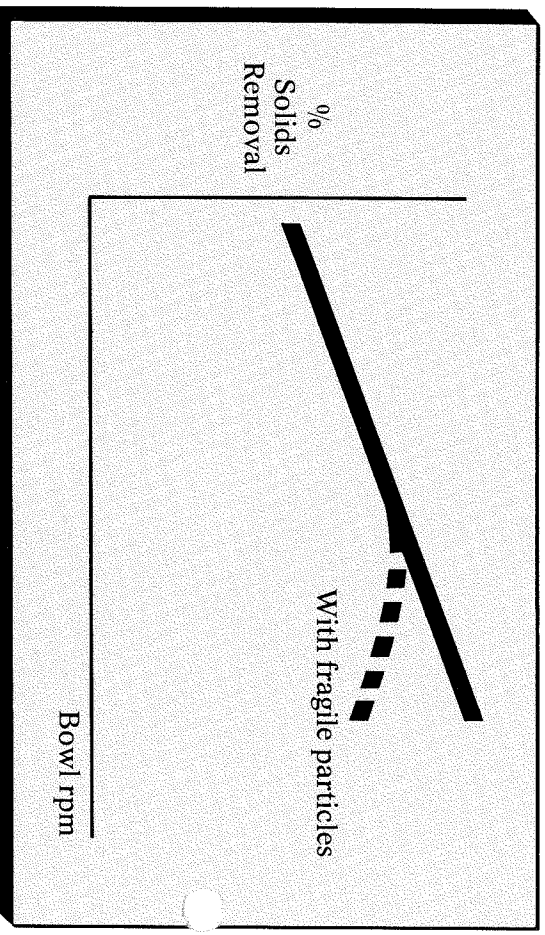
BOWL SPEED

High speed (high centrifugal acceleration) improves both clarification and dewatering effect up to a limit where solids tend to slide back into the pond or where fragile particles are shattered by heavy acceleration forces. The optimum speed for solids capture varies according to the nature of the solids.

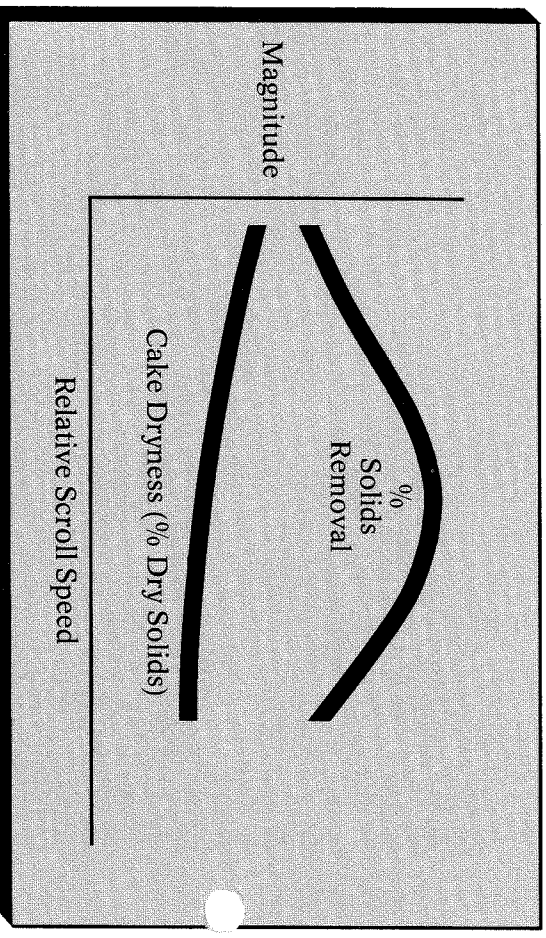
RELATIVE SCROLL SPEED

Up to a certain limit, faster scrolling improves solids capture (clarification) at the expense of cake dryness. Variable scroll speed is standard on some Alfa-Laval decanters, optional on others.

Speeds are adjusted by fitting vee-belt pulleys of suitable size to the motor, bowl and sunwheel shafts. Hydraulic control of relative scroll speed is available.



Effect of bowl speed.



Effect of relative scroll speed.

OUT OF YOUR DECANter

POND DEPTH

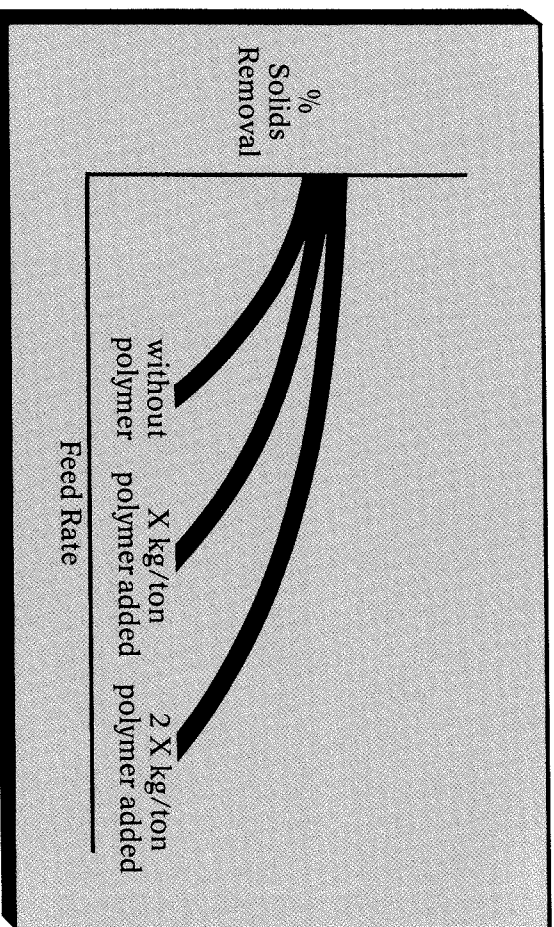
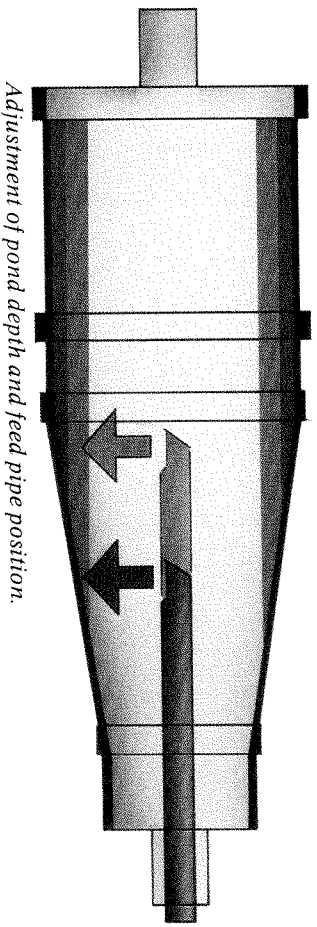
A shallow pond setting with a long beach gives dryer solids. A deep setting with a short beach gives a clearer effluent. In some models the feed pipe is axially adjustable, enabling the feed to be delivered to the pond/beach transition zone regardless of pond depth.

Different models are equipped with different types of depth setting device, but all are adjustable from the outside of the bowl.

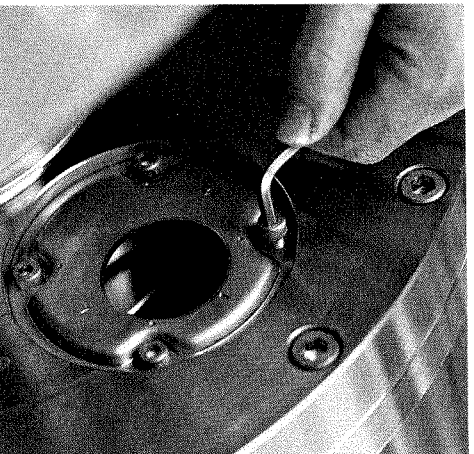
FEED RATE AND ADDITIVES

Solids capture can be improved by a reduction in the feed rate.

In the great majority of cases, decanter centrifuges do a good job of separation without benefit of chemical additives. Certain very fine types of sediment (such as sewage sludge) do however need to be flocculated to make them separable. This applies regardless of whether decanters or filtration equipment are employed for the purpose. Flocculants are very expensive, so it pays to exploit the other tuning possibilities of the decanter to the full in order to minimize the dosage.



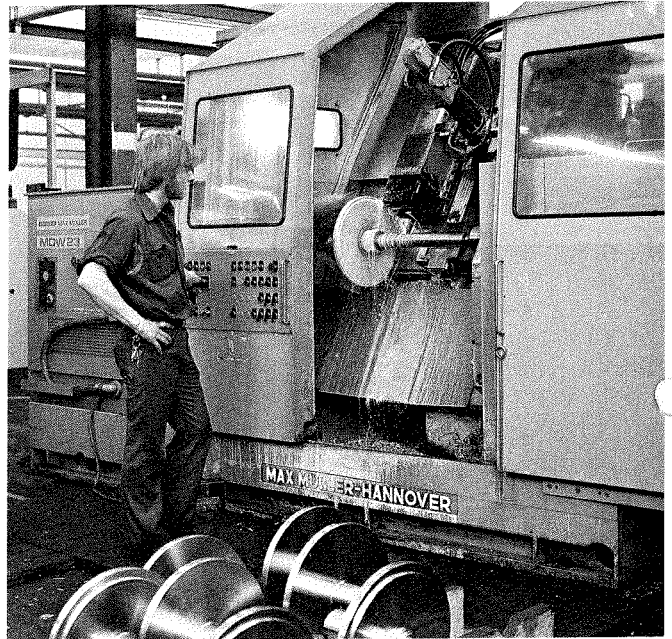
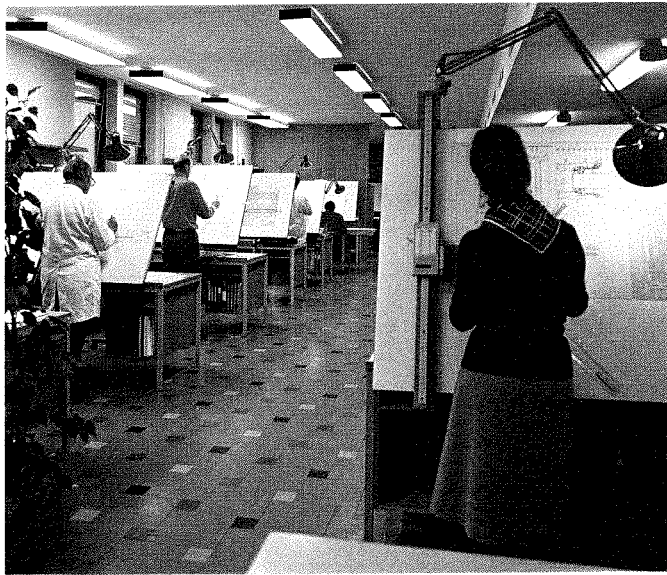
Effects of feed rate and flocculant dosage.



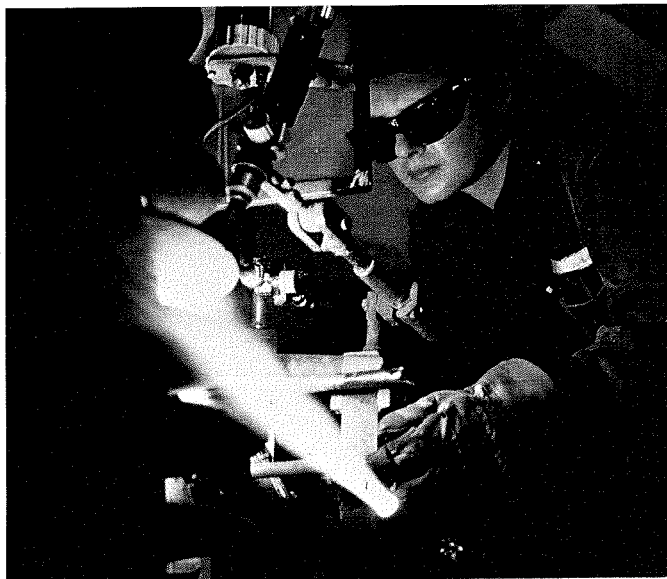
Pond depth adjustment (NX 418). The orientation of the eccentric weir plates determines the overflow radius of the effluent.

THE ORGANIZATION BEHIND YOUR ALFA-LAVAL DECANTER

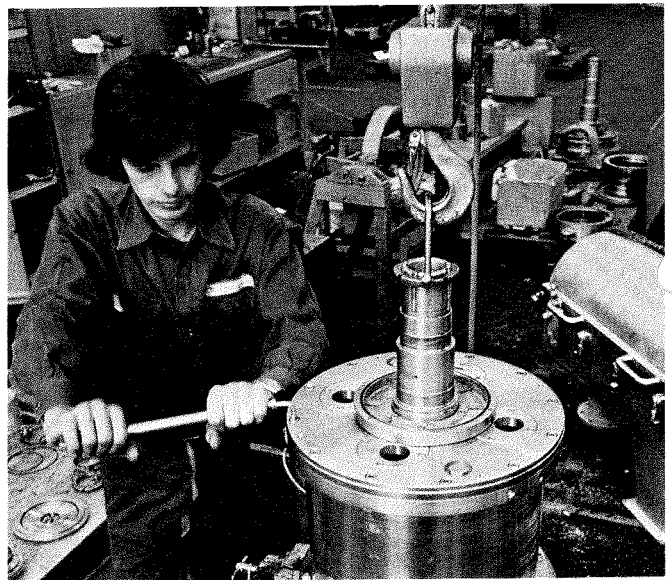
Alfa-Laval Separation Copenhagen is the Decanter Centre of the international Alfa-Laval Group. Product development work on decanters is carried out in close collaboration with the Group's various Application Centres to produce a range of machines matched to the needs of industry.



Our large decanter factory in Copenhagen is equipped with the most modern automated machine tools.



Some operations, like hardfacing the scroll flights, require the personal attention of highly skilled craftsmen.



After-sales service, spares and repairs are provided through Alfa-Laval companies and representatives in 125 countries.

ALFA-LAVAL

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