New Developments for Waste Paper Preparation

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SUMMARY

Because of the general shortage of raw materials, the paper industry is increasingly dependent on the use of waste papers. On the other hand, for economic reasons, the waste paper trade is generally not in a position to offer the required grades with the desired degree of purity at favourable prices. Manufacturers of machinery for waste paper preparation are therefore called upon to steadily further develop slushing, cleaning and screening processes. This paper reviews such new developments, presenting, in addition to new screening and cleaning equipment, waste paper pulpers with waste removal systems for the early separation of junk and unproblematic continuous operation. Furthermore, the newly developed tubular injector cell for the removal of printing inks is explained.

General trends and new processes in waste paper preparation are described.

SLUSHING

In the slushing system of today for the preparation of contaminated waste paper, the pulper is always to be considered in conjunction with its associated peripheral units.

The general trend is to conduct only coarse slushing in the pulper itself in order to keep all kind of contraries large enough to be screenable. Subsequent machines matched to the particular pulper design ensure the further removal of extraneous matter and deflaking.

The hole diameters of the pulper screen plates are therefore today relatively large, averaging about 18–30 mm.

Two different slushing sy stems can be offered :
—Slushing at medium consistency.
—Slushing at high consistency.

Slushing in the Medium Consistency Range (Fig. 1)

For the continuous slushing of mixed, unsorted waste papers, the newly developed pulper type VAP (vertical pulper with sloping bottom) is used in addition to the pulper type AP (horizontal pulper), which has proven successful in numerous installations. These pulpers are characterized by the following design features :

—Continuous operation in the 4.5–5% consistency range.

—Good separation of heavy contaminants without extreme wear of rotor and screen plate.

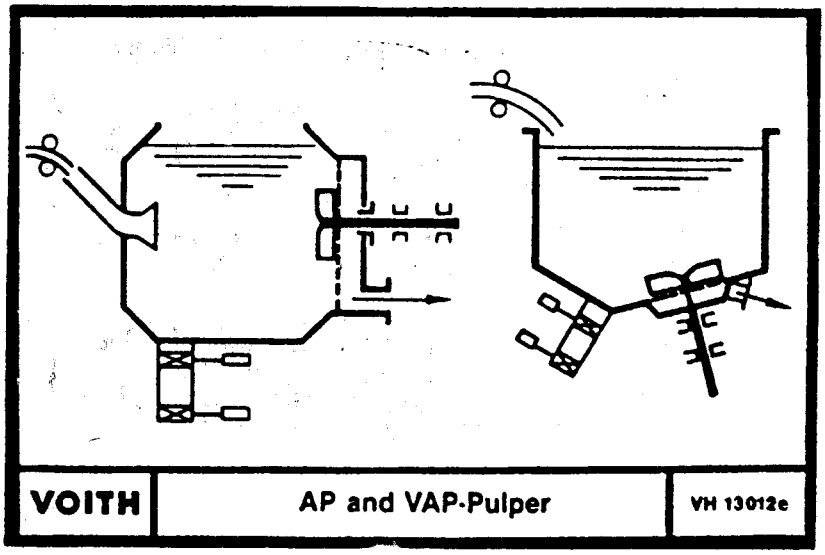

Fig. 1

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—Good strand formation.

In the design of the VAP pulper, special attention was paid to favourable hydraulic conditions and reliable, observable formation of strand.

Removal of Waste from the Pulper by Contaminex (Fig. 2)

The growing proportion of contraries in waste paper calls for almost continuous removal of the contraries from continuously operating pulpers in order to avoid shutdowns for cleaning.

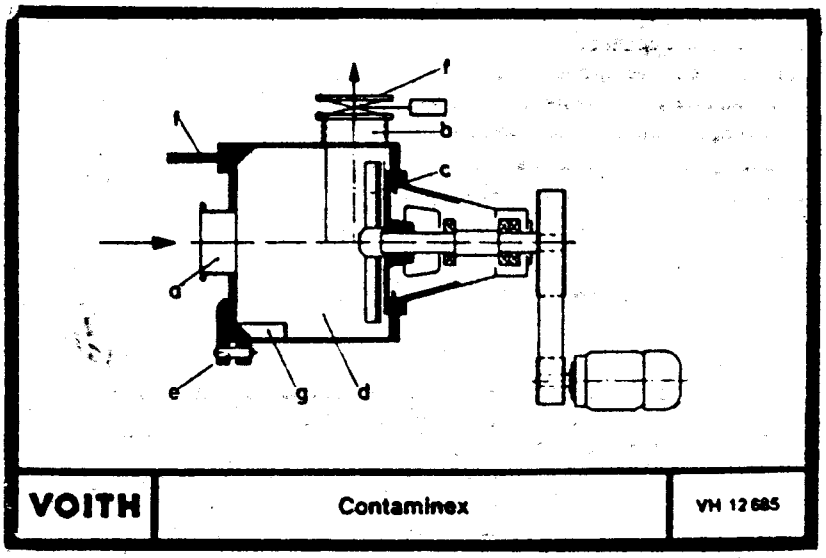


Fig. 2

A machine suitable for this puspose should have :

—Simple connectability to all types of vertical and horizontal pulpers.

—Simple and rugged mode of construction with little control effort.

—Very good separation of lightweight contraries and fibres (specks), therefore negligible loss of fibrers in the subsequent screening stage.

—Pump effect.

The CONTAMINEX fulfills these demands.

It has thereby become possible to remove waste from pulper over an unlimited period of time without manual effort and downtime. The additional pump effect permits the separation of contraries at a point which is suitable for transporting them away.

Figures 3–5 show schematically the arrangement of the CONTAMINEX together with the various types of pulpers. The rejects of the vibration screen following the CONTAMINEX can be seen in Fig 6.

Soaking Drum (Fig. 7)

The soaking drum can precede continuously operating pulpers of all types and is characterized by the following special features :

—Around 15% savings in energy during slushing.

—Throughput increase of existing pulpers up to about 80%.

—Uniform charging of pulper and thus easing of stock consistency and level control.

—Favourable influencing of strand formation.

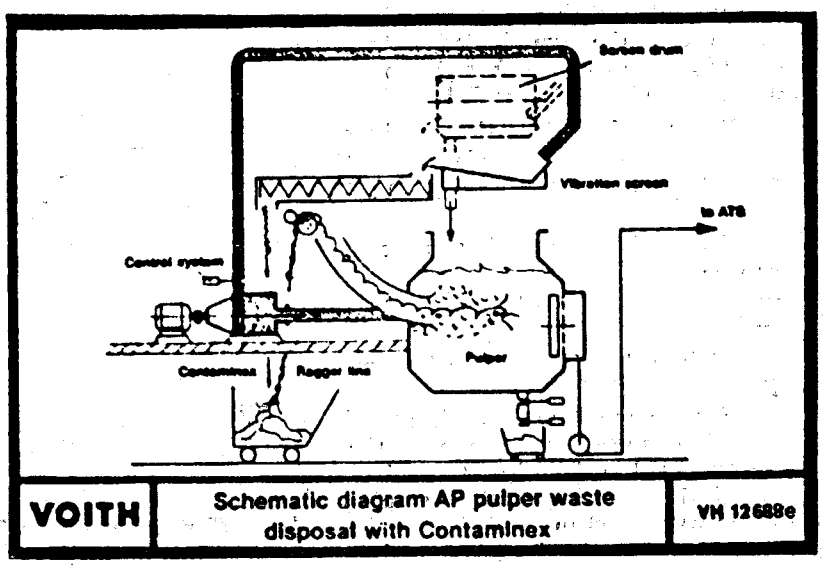


Fig. 3

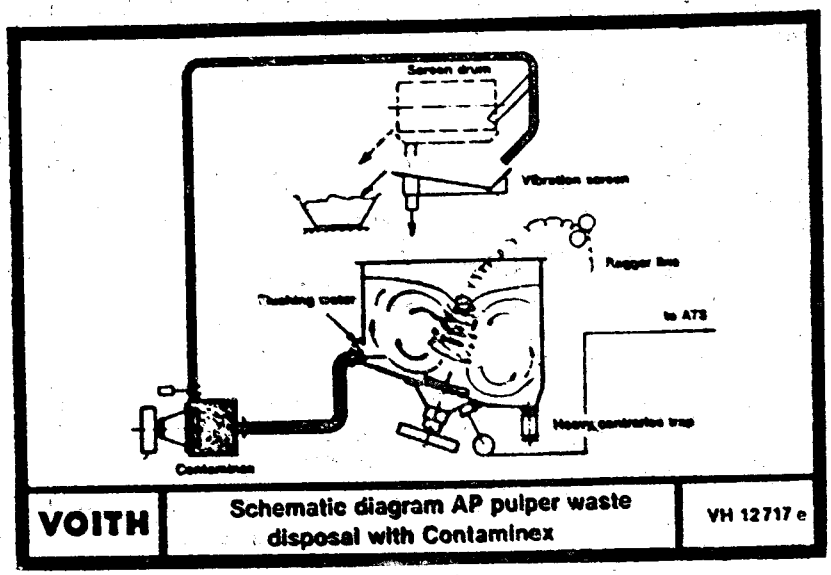


Fig 4

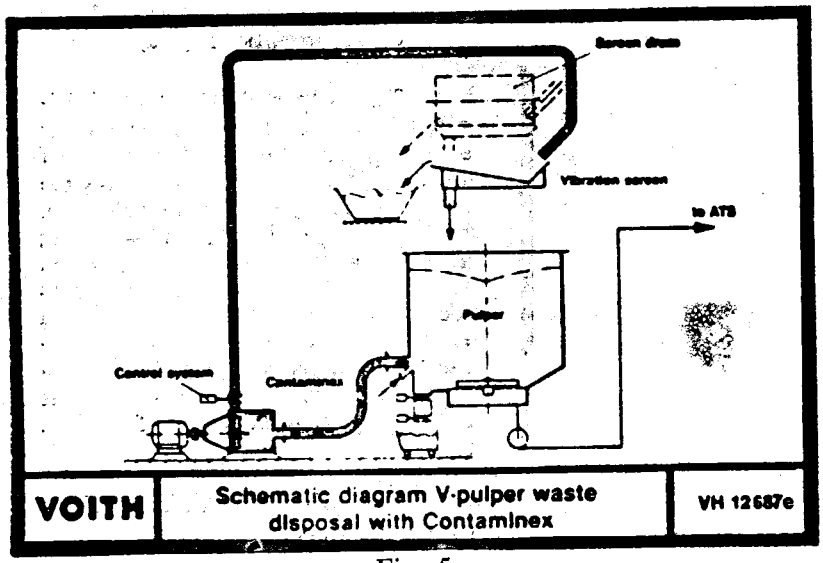


Fig. 5

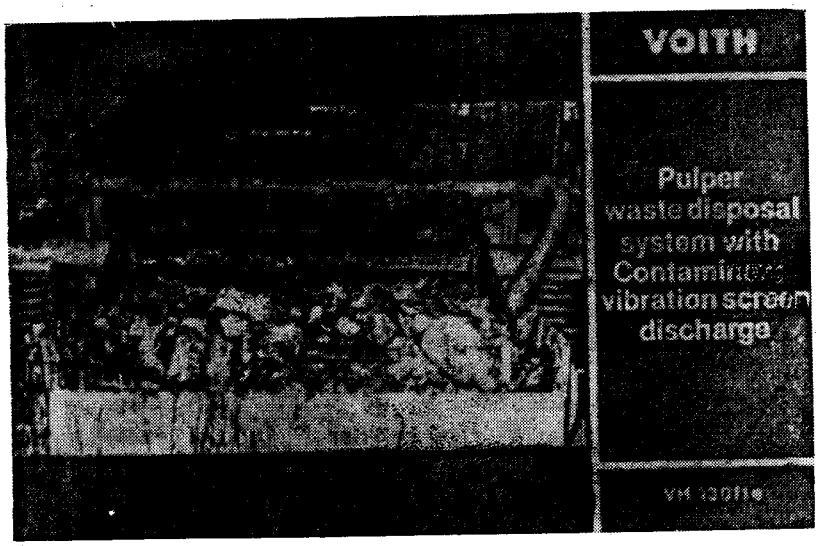


Fig. 6

High-Consistency Slushing (Fig. 8)

The high-consistency pulper is operated batchwise, with filling carred out in the conventional way. Slushing takes place at consistencies between 12 and 18% b. d. (in some special cases even higher). The most important element of this pulper type is the rotor (Fig. 9); it must be capable of slushing the fibre material, which is virtually no longer fluid at over 12% b.d. stock consistency. The helical slushing elements are arranged so that a vertical flow to the bottom of the vat is generated and also so that a horizontal reVersal occurs.

The experience and advantages can be summed up as follows :

— With both easy-and difficult-to-slush grades an energy saving up to 20% can be achieved.

— Very difficult-to-slush waste papers, such as one-or two-side polycoated material, or wet strength papers, are now able to be reused as precious fibre material.

— Gentle slushing due to intensive fibre-to-fibre friction.

— Chemical and steam savings in case of slushing of resistant waste papers, or in deinking plants.

— No or only marginal reduction in size of plastic or other extraneous matter.

— Redilution during discharge outside the vat means there is no need for a bigger vat size.

— Low floor space requirement.

Voith high-consisteny pulpers are supplied in three different designs :

— With horizontal bottom and screen plate under the rotor for relatively clean raw materials (Fig. 10). After slushnig, the pulper is emptied like a conventional pulper, with the dilution water being meterd to a high-turbulence zone arranged under the rotor.

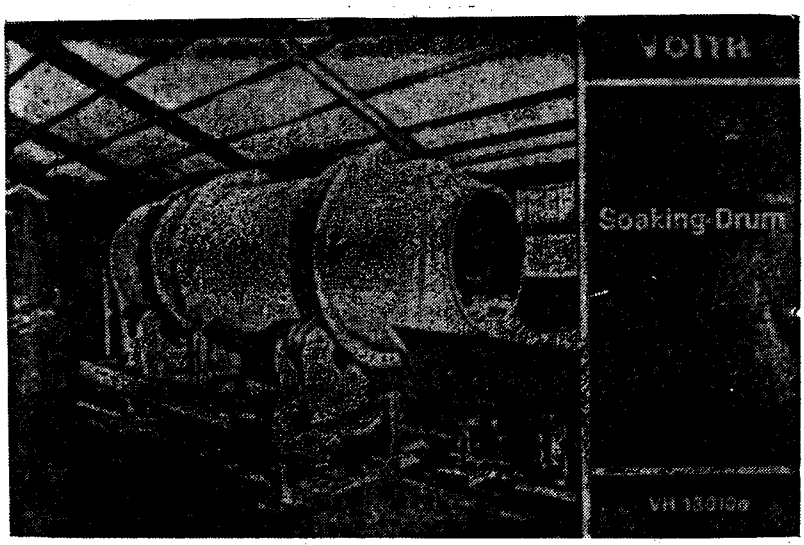


Fig. 7

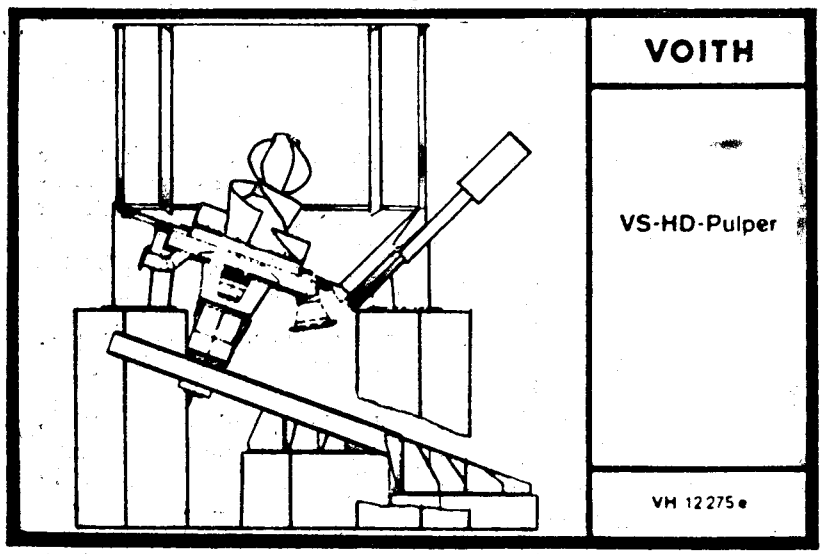
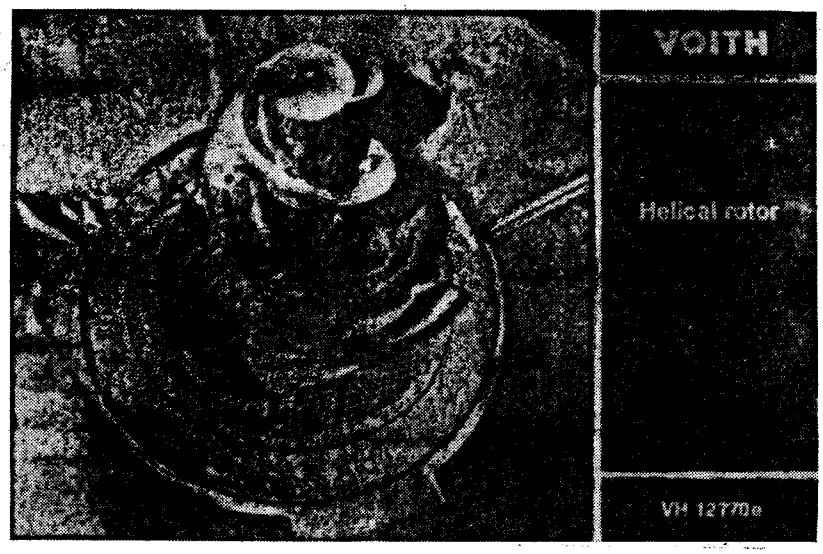


Fig. 8



Fg 9

— With horizontal bottom with out screen plate with of CONTAMINEX "S" for raw materials with a high percentage of contaminants Fig: 11). Emptying is done via the CONTAMINEX "S" with the dilution water being added ahead of the CONTAMINEX. The addition of dilution water is controlled in such a way that the contaminants retained in the CONTAMINEX are washed out at the end of the emptying process and can subsequently be discharged free from fibres.

— With a sloping bottom and an additional large trash discharge opening in the lowest part of the pulper for furnishes with a high-turbulence contaminants (Fig. 8).

The pulper discharging initially takes place through the pulper screen plate with the addition of water into the high-turbulence zone, as mentioned before (Fig. 10). Towards the end of the discharging process, a pneumatically operated valve with a large square cross sectional area on the trash opening is opened and the retained extranous matter is discharged into a screening and dewatering drum at consistencies of about 4—5 % b.d. (Fig. 12).

SCREENING AND CLEANING :
Screen Drum (Fig 13)

The screen the reject flow from the CONTAMINEX, screen drums of various sizes are most suitable.

Those rotating screen drums have low energy requirement and high throughput capacity. Choice of several sizes and perforations permit adaptation to a wide variety of screening tasks at stock consistencies between 3 and 5%.

Besides reject screening for the CONTAMINEX, the screen drum is used :

— After high-consistency slushing as already mentioned above
and for

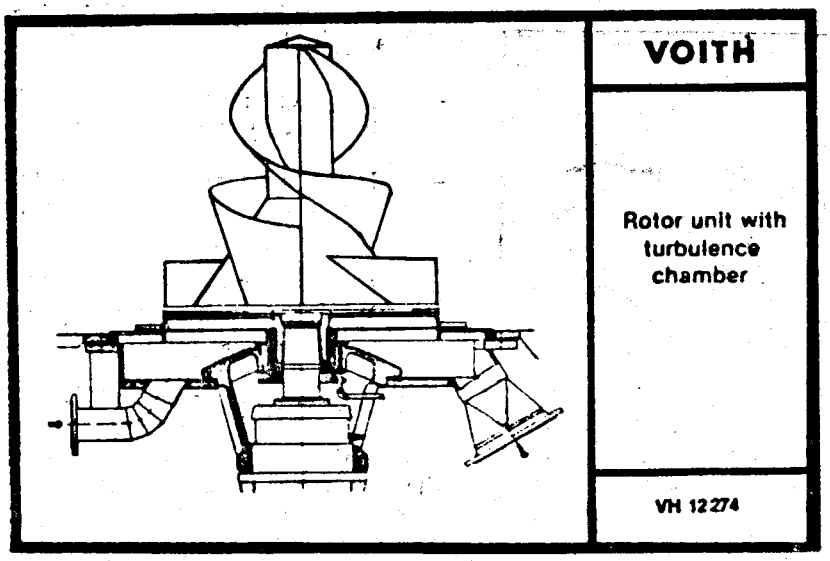


Fig. 10

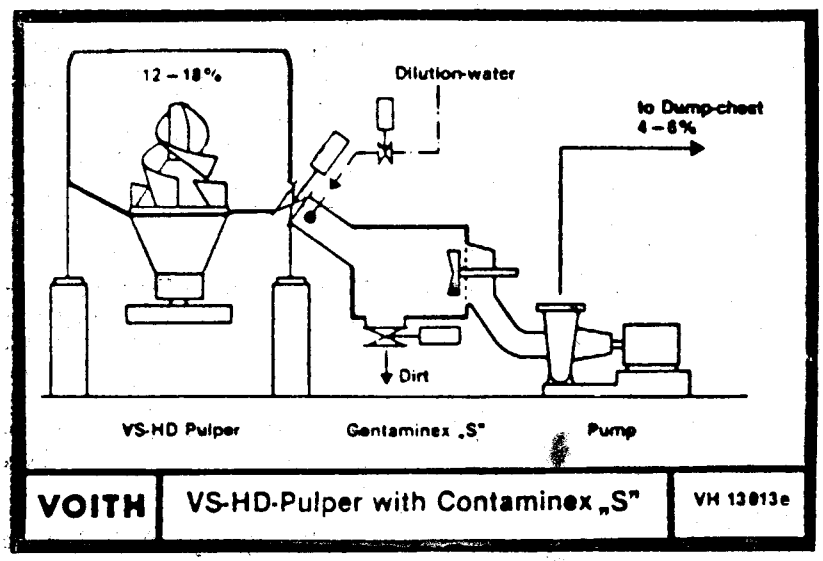


Fig. 11

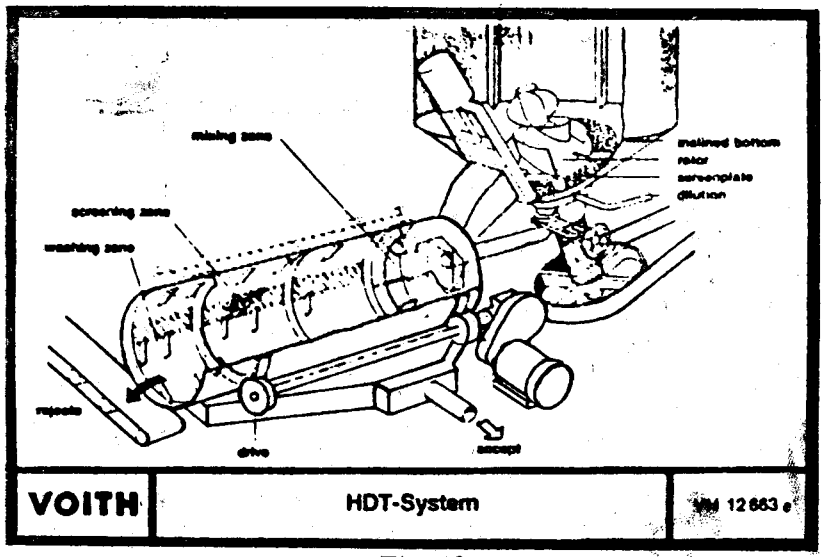


Fig. 12

— prescreening in multi-stage high-consistency screening systems.

Sortex (Fig. 14)

A final-stage screening especially for the screening of lightweight contraries from the well-known TURBO SEPARATOR.

— Closed mode of construction.

— No check necessary as with vibration screens.

— Rejection of contraries at high consistency (15—20% b.d.), therefore easier transport of the contraries to the dump with less percentage of water.

Turbowasher (Fig. 15)

The Turbowasher was developed chiefly as end-stage screen after the TURBO SEPARATOR for medium to high production rates. At production rates up to about 100 t/24 h, it is also possible to use it in the full flow instead of the TURBO SEPARATOR. The main advanatges of this machine are as follows :

— Optimum screening efficiency by means of small perforations (as a rule smaller than those in the TURBO SEPARATOR).

— Forward arrangement of the accepts, i.e., no circuit burden due to stock circulation.

— Minimum loss of fibres as a result of intermittent mode of operation with rejects washing.

Turbosorter (Fig. 16)

This pressure screen is a very effective machine that can be used at stock consistencies around 3.5 to 4% for the early discharge of plastic and stickies by means of very narrow slots of 0.35–0.55 mm.

— High screening efficiency in the medium stock consistency range of 3—4%, therefore

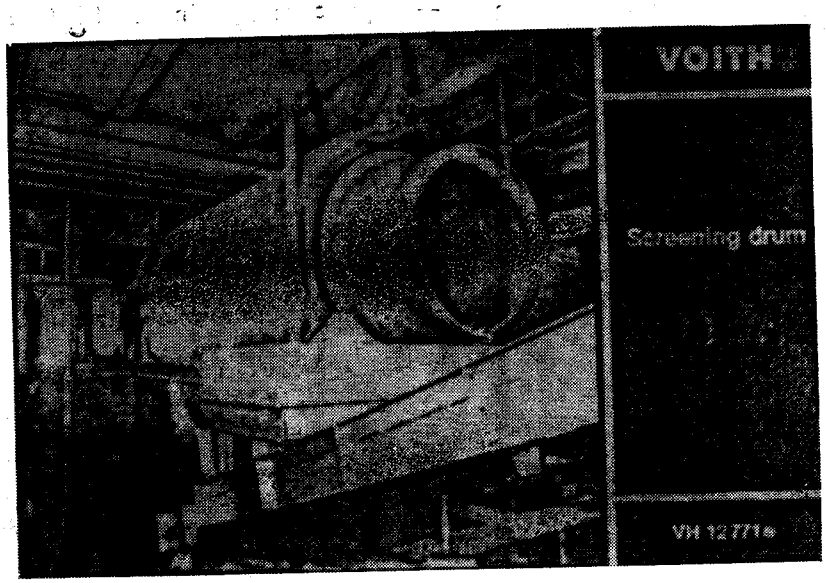


Fig. 13

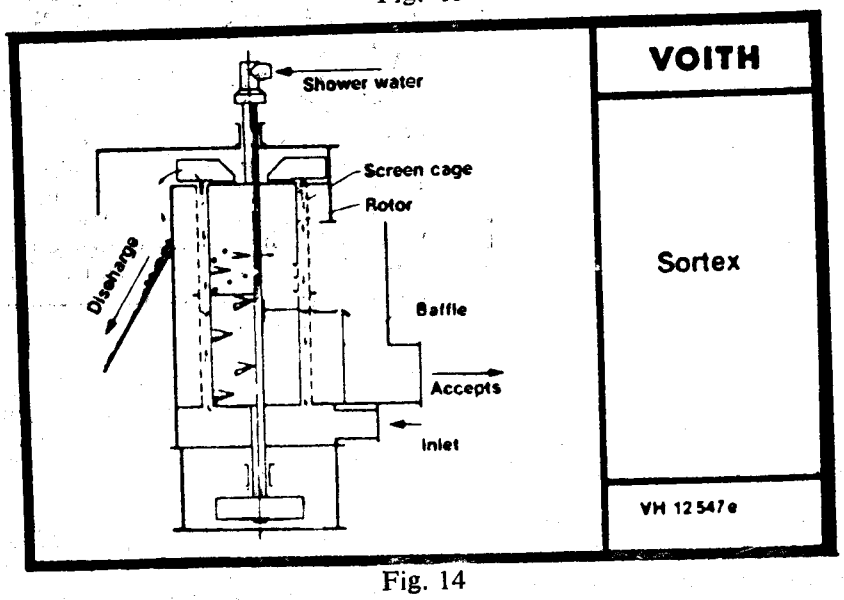


Fig. 14

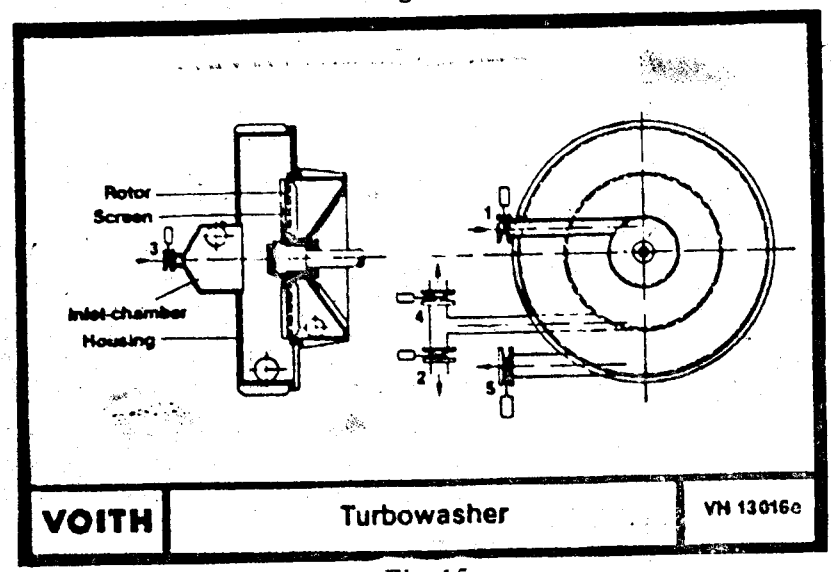


Fig. 15a

no subsequent thickening required.

— High screening capacities with low energy requirements.

— Low discharge of rejects, therefore low tailing screen capacities required.

— Installed after TURBO SEPARATOR or as 2nd stage in large systems.

Multifractor (Fig. 17)

This closed machine permits the splitting (fractionation) of a waste paper suspension into long and short fibre components. This results in the following advantages :

— Short fibre fraction virtually clean, enriched with fines and ash.

— Long fibre fraction thickened, contains virtually all valuable (long) fibres.

— Fractionating effect controllable in wide ranges, depending on raw material (e.g., long fibre fraction 30—70%).

— Only the long fibre component is refined and, where necessary, predispersed.

— Small quantity of stock to be processed.

— Higher efficiency because of increased stock consistency.

— Less energy required, increased strength.

— Use of fractions for various products.

Slotted Screening (Low-Consistency Stock)

The development of new types of screen basket facilitates the breakthrough in the separation of stickies and very small (cubic) impurities with high screening capacity and low energy requirement and permits new screen

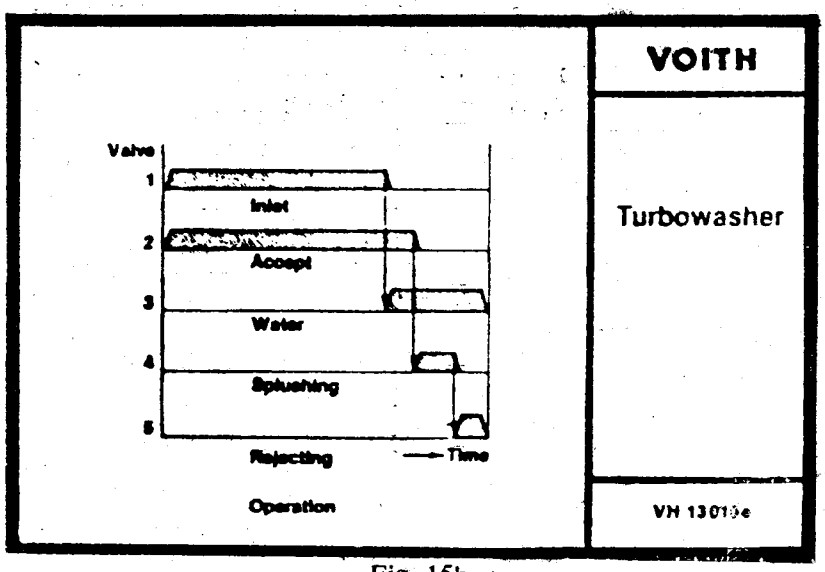


Fig. 15b

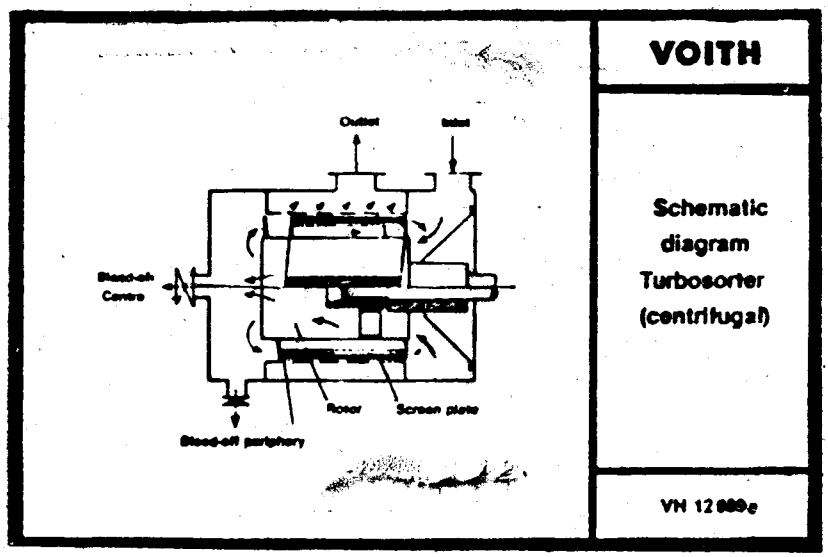


Fig. 16

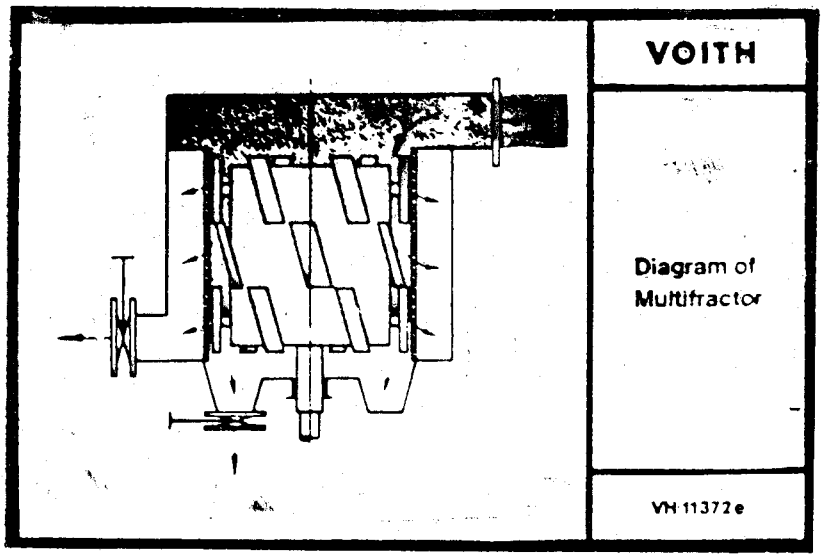


Fig 17

designs with slot widths from 0.15 mm.

Further advantages :

— Small quantities of rejects.

— Low rejects thickening factor.

— Low fractionating effect.

NEW TAILING SCREEN

Minisorter Washing Screen (Fig. 18)

A smaller, modified machine has been derived from the screen mentioned before, which is used chiefly as the last stage of slotted screening systems (after Turbosorter and vertical screens).

It has the following advantages :

— High throughput in the low-consistency range with low energy requirement.

— Very narrow slot widths from 0.2 mm.

— Very low fibre loss thanks to washing out and periodic discharge of the rejects.

It will therefore replace the vibration screens used for this purpose up to now, whose system-related disadvantages are thus avoided.

DEINKING PLANTS

Tubular Injector Cell (Fig. 19)

The tubular injector cell, which has meanwhile proven successful in several plants, produces excellent results thanks to :

— Highly favourable flow geometry.

— Central, plugging-free injector with automatic intake of air and low differential pressure.

— Introduction of high, optimum quantities of air,

— Completely closed mode of construction.

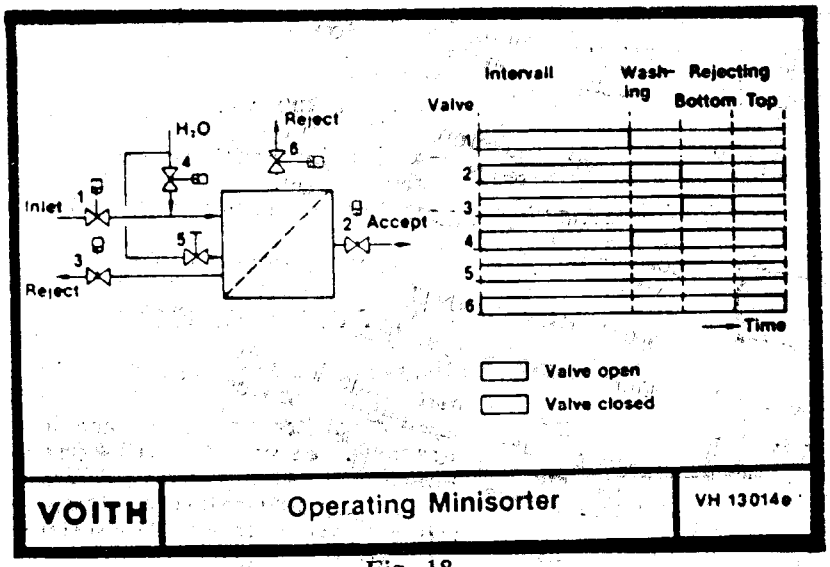


Fig. 18

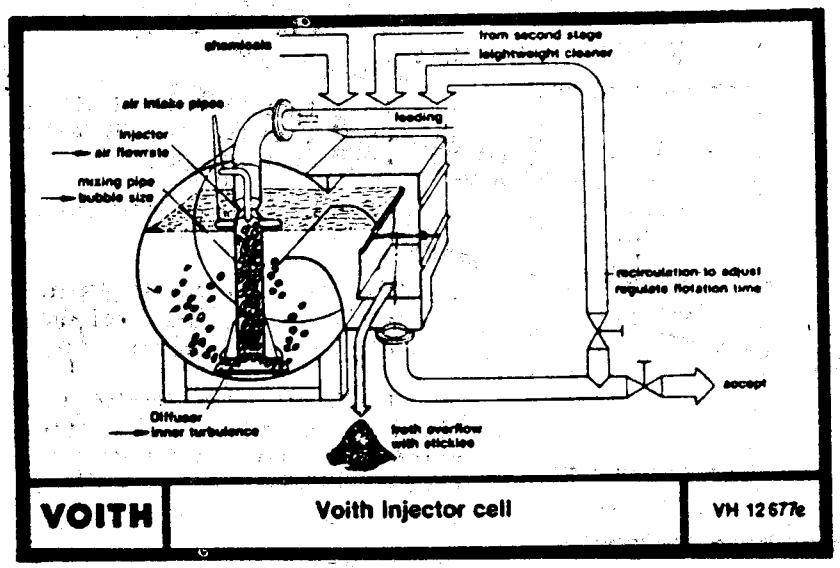


Fig 19

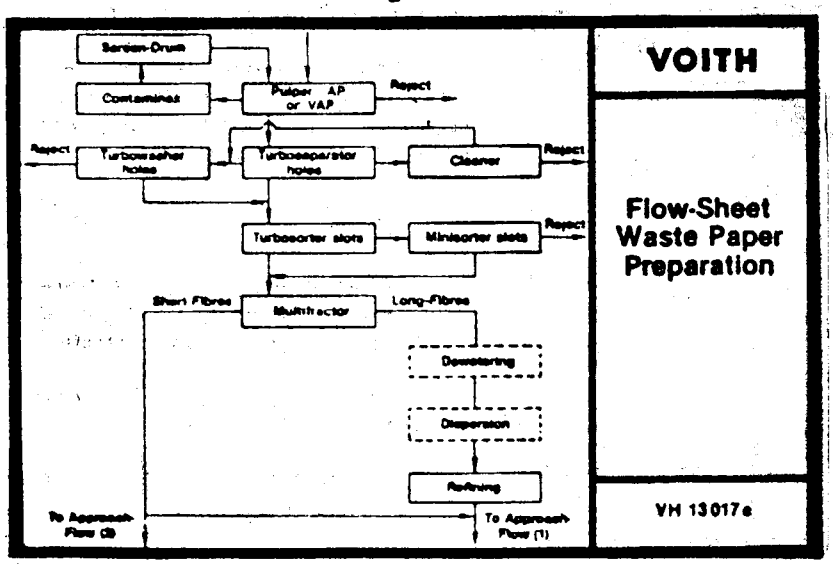


Fig. 20

This results in the following major advantages as compared with cells with dispersing unit :

— Approx. 30% shorter flotation time for the achievement of maximum removal of printing inks, therefore fewer cells required.

— Approx. 30% lower space requirement and lower capital cost.

— Higher production capacity per flotation line.

— Lower specific operating requirement (pump energy) of approx. 24 kwh/t (incl. secondary stage and return stock pump).

TRENDS AND NEW PROCESSES

All Voith's new developments and processes aim at 4 main aspects :

— Operational reliability of the machinery and equipment.

— Economic efficiency.

— Best technological values.

— Maximum purity of the prepared stock.

In the last few years Voith research has centred on the development of processes and machine to overcome the 'stickies problem'. A report of the first results was given at the PTS Symposium in Munich on February 22 and 23, 1983.

To achieve these aims, the machines described under 1—3 were developed as supplementation to the processes already known.

Now some examples explaining the application of the beforementioned machines :

Preparation of Papers for Corrugated Board Production and for Board Filler Stock (Fig. 20)

— Continuous slushing in the AP pulper with good strand formation and separation of heavy contraries.

— Unlimited continuous operation thanks to removal of lightweight contraries by means of CONTAMINEX and drum.

— Predeflaking, prescreening with small perforations and high-consistency cleaning by TURBO SEPARATOR with centrifugal cleaner and Turbowasher.

— Excellent separation of plastic, foils and stickies by means of subsequent Turbosorter and washing screen.

— Fractionation with separate refining in the long fibre line. Where required, dispersing prior to refining.

This process is characterized by few, highly effective stages and the little operating effort required. It no longer necessitates any deflaking and permits unproblematic conveyance on to the approach-flow system. Fractionation in particular permits the production of several layers or the feeding of two machines from one raw material and with one preparation system.

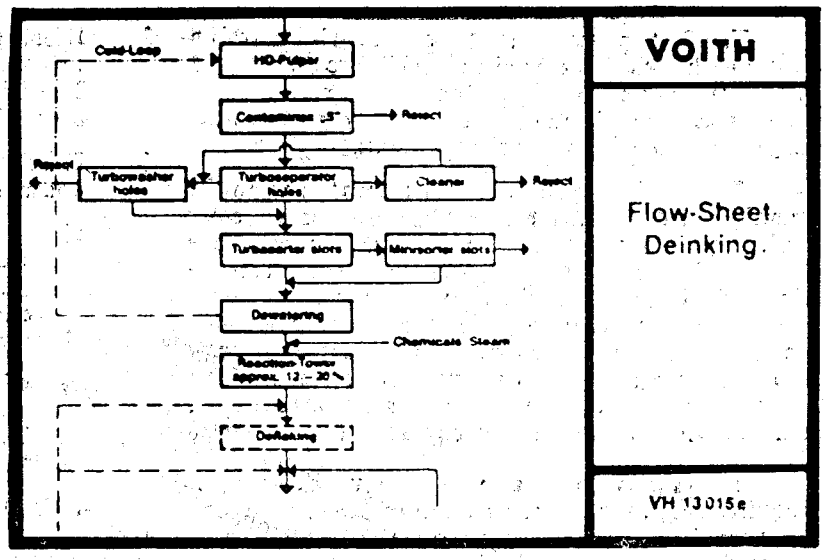


Fig. 21a

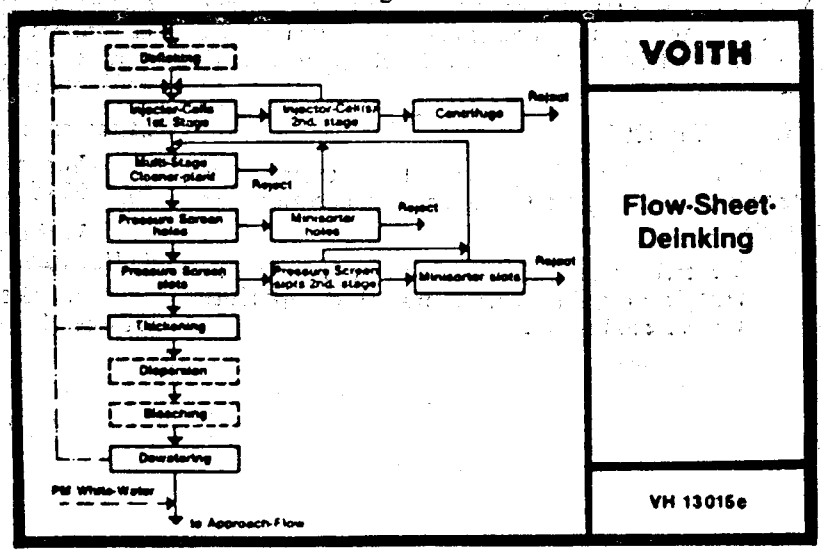


Fig 21b

Deinking Systems (Fig. 21)

Here, in addition to as low a consumption of energy and chemicals as possible, two main aspects are given priority :

— Best possible detachment of printing inks and discharge.

— Maximum purity of the stock, especially when used for graphic papers and on high-speed twin-wire formers.

A system which meets these demands consists of an HD pulper with CONTAMINEX "S" for the earliest possible separation of coarse lightweight impurities.

— TURBO SEPARATOR with small holes and Turbosorter with very narrow slots, as well as the tailing screens already mentioned.

— Belt thickener with reaction tower.

— Deflaking (only for inks that are very difficult to detach).

— Tubular injector cells with centrifuge for the foam of the secondary cells.

— Fine cleaning by special centrifugal cleaners with discharge of lightweight contraries.

— Fine screening by pressure screens with very small holes and very narrow slots, slotted screening multi-stage with washing screen.

— Thickening and dewatering of the stock, if necessary with intermediate arrangement of a ble aching and/or dispersion stage.

The first process stage up to the reaction tower with closed water circuit, the so-called 'Cold Loop' (without heating of the stock) ensures that stickies can be discharged at an early stage in the largest possible form without softening.

The high-consistency stock treatment in the reaction tower minimizes chemical and steam costs and, together with the high-consistency stock slushing stage, permits the separation of difficult (offset) printing inks. Final dewatering prevents the deinking chemicals from entering the paper machine. The flotation process is also characterized by the extensive closing of the water circuit, high yield and small quantity of effluent with low burden of contaminants.

In systems in which extensive deashing is required, e.g., for the production of sanitary papers, we therefore prefer to carry out the deashing in a separate stage after flotation, with the washing water to be clarified accumulating in small quantity, as well as not containing any printing inks and dirt particles, which substantially facilitates clarification.

CONCLUSIONS

The leading factors for the selection of machines for a waste paper preparation are mainly :

1) Effective slushing at high or medium consistency leaving the plastic and other impurities in a screenable size.

2) Discharge of impurities at a very early stage and without manual intervention using CONTAMINEX, TURBO SEPARATOR, screening drum, Turbowasher, etc.

3) Effective cleaning and screening at medium consistency.

   a) Of flat and relatively coarse cubic particles by means of perforated screen plates with TURBO SEPARATOR special cleaner, Turbowasher, etc., in the "A-stage", and

   b) of plastic and lightweight cubic particles by means of slotted screen plates with Turbosorter, Minisorter, etc, in the "B-stage".

A further advantage is that even existing stock preparation systems can be simplified by using fewer but selected machines with higher efficiency, improving more uniform operation without interruptions and consequently possibility of more effective automatic process control, resulting finally in lower operation costs.

Literature :

Wochenblatt fur Papierfabrikation, No. 23/24, Page 927-936 (1981)

Wochenblatt für Papierfabrikation, No. 11/12, Page 376—376 (1983)

D. Bergfeld—Appita-Meeting, Melbourne, October 12, 1983.