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ENVIRONMENT & MONEY SAVING WITH MODERN SLUDGE HANDLING SYSTEMS

I. Abstract

An ever-increasing amount of sludge from paper production is calling for intelligent solutions for sludge handling & dewatering. Keywords are high costs for dewatering, handling and disposal of the sludge. In the past it was common practice to transport the sludge to land fill locations and bury the problem. Today, modern paper mills make the sludge and also other rejects, part of their operation and environmental concept by making use of 'waste' and converting it into a valuable fuel for power plants and boilers. The following article shows how Bellmer is able to provide solutions to dewater various type of sludge (primary, secondary, biological or mixed) with different type of technology and machines available with them.

Step 1 – Pre-Thickening

The first step is to thicken the sludge to a consistency, which is a good base for the following machine. There are 2 options available for pre-thickening; although in some cases, existing equipment can be incorporated, as we will see later in our case studies.

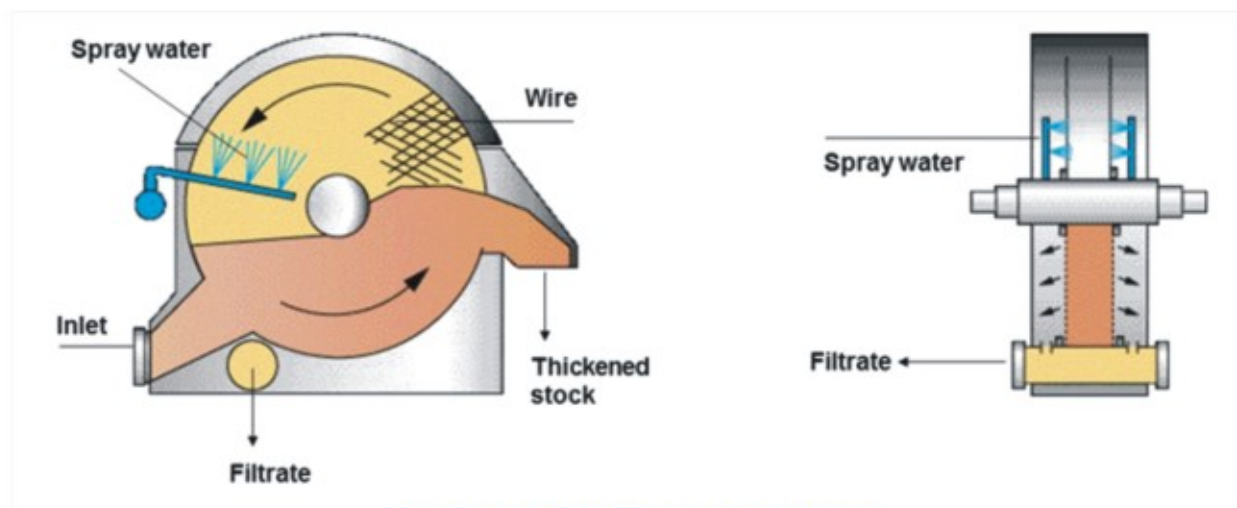
1 DISC Thickener – It is a gravity disc thickener. Compact, custom-made for every application, small footprint, easy to operate, low power consumption and very little maintenance.

AKSE F / S: Hydrostatic disc thickener

AKSE F
• Fibre thickening

AKSE S
• Sludge thickening

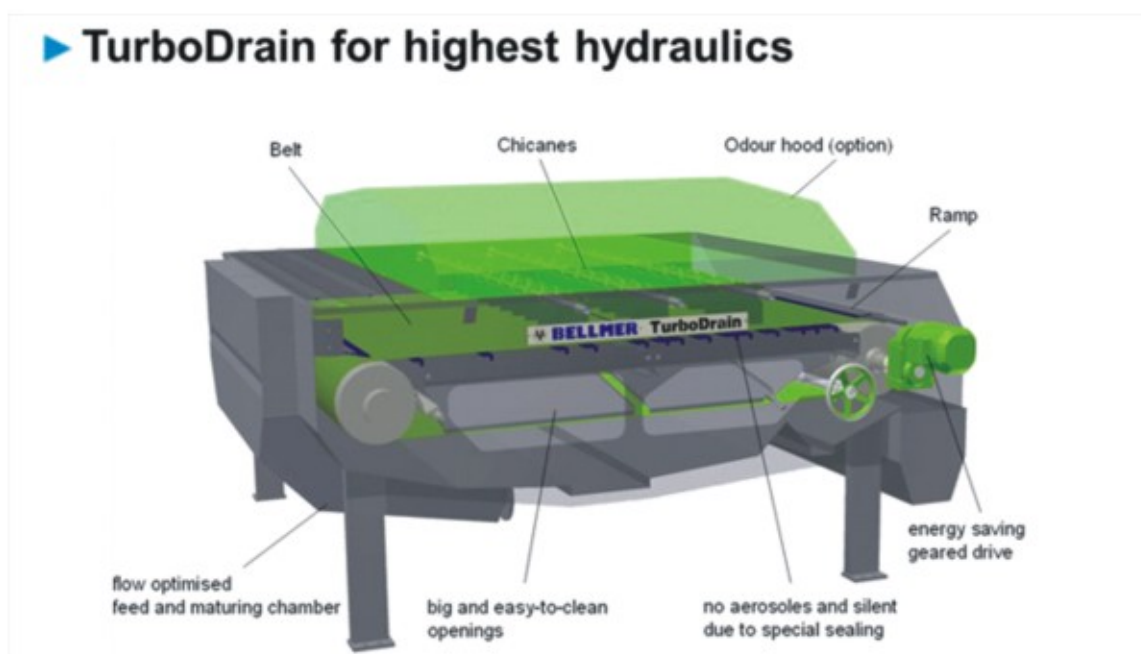




Pic. 1 & 2 - Gravity Disc Thickener

The first step is to thicken the sludge to a consistency which is a good base for a screw press to dewater this sludge to the highest possible level. It also helps to keep the size of the screw press on a payable level in terms of size, as this is by far the most expensive part of your investment. The sludge is channeled between a pair of discs and with the help of a very slow rotation of those discs (3 rpm at 50 Hz) the sludge is being dewatered through a conventional 20 mesh stainless steel wire mesh. No vacuum is applied. The sludge will reach the outlet of the disc thickener once it reaches to a certain consistency. The thickener can deal very well with varying sludge conditions, such as inlet consistency or ash content. A simple, but very effective way of pre-dewatering of sludge.

2. Turbo-Drain - The Turbodrainer is a gravity belt thickener with highest hydraulic through put. The Turbodrainer can thicken huge amount of sludge in very short time. Different inlet concentration will also be equalized by Turbodrainer. It is possible to achieve a very good filtrate quality (around 50 – 100 ppm) with Turbodrainer and the filtrate can be reused for the shower pipe of Turbodrainer and Winklepress. So normally no foreign water for belt cleaning is required. At the discharge of the Turbodrainer the dry solid content of the sludge will be approx. 8 – 15 %.

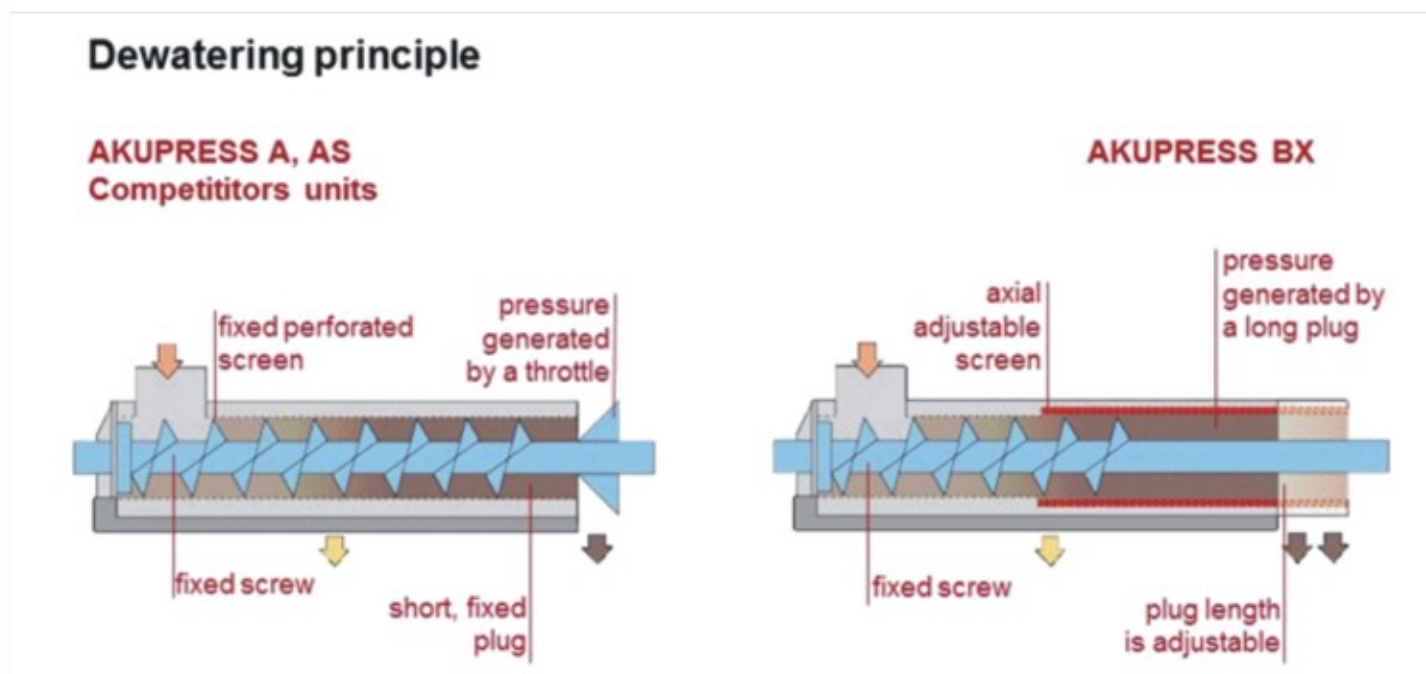


Pic. 3 : Turbodrains Functional description

Step 2 – De-watering of pre-thickened sludge- We are able to thicken any type of sludge with our machines. Depending upon the type of sludge, we can decide which one to use. Mainly 2 options available:

Option 1 - Modern Screw Press Technology

Here we see a screw press for sludge dewatering with a unique technology, the movable screen basket design for extra high sludge dryness.



Picture 4 – Screw Press technologies

On the left hand side you see a conventional type of screw press as manufactured by all screw press manufacturers. The main features here are:

1. A short plug,
2. The exit of the press is closed with either a cone or some flaps. Both the cone and the flaps are pneumatically controlled. This leads to a build-up of pressure and the sludge is then dewatered through stationary screen baskets. Once a certain pressure is reached the cone or flaps are being pushed open and the dried sludge can exit the press.

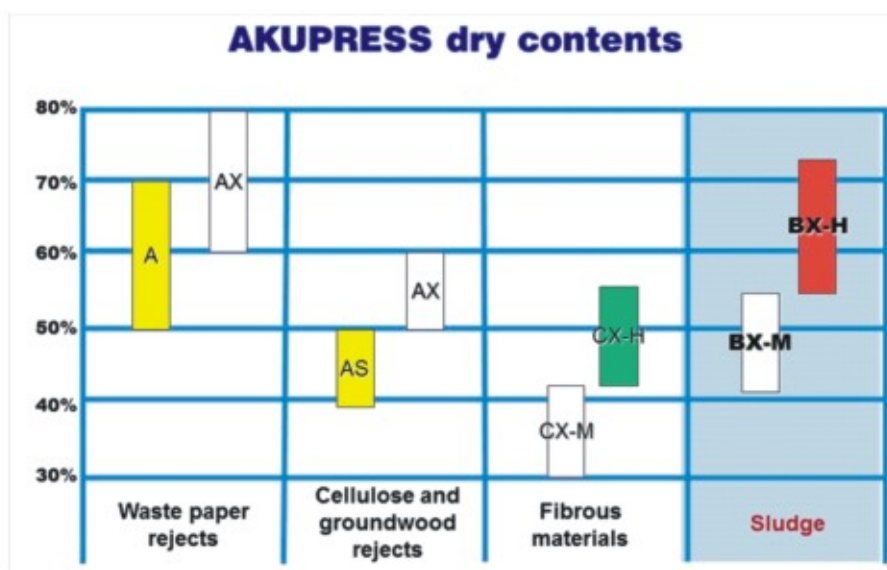
On the right hand side of this picture you can see a unique and new design. The main features here are:

1. A very long plug,
2. An additional set of screen baskets mounted into a movable frame enabling the screw press to lengthen and shorten the plug area which is the area with the highest pressure. This press is in the position to apply the highest possible dewatering pressure of any screw press and because of those movable baskets can adjust to changing sludge conditions and still achieve a very high and constant sludge consistency. The movable basket is operated by a hydraulic system which is part of the screw press supply.



Picture 5 – New Technology Screw Press

On this picture you can see the part of the press which is movable. It is being guided along those guiding tubes. The press is being produced in many different sizes and designs depending on throughput and type of sludge being treated.

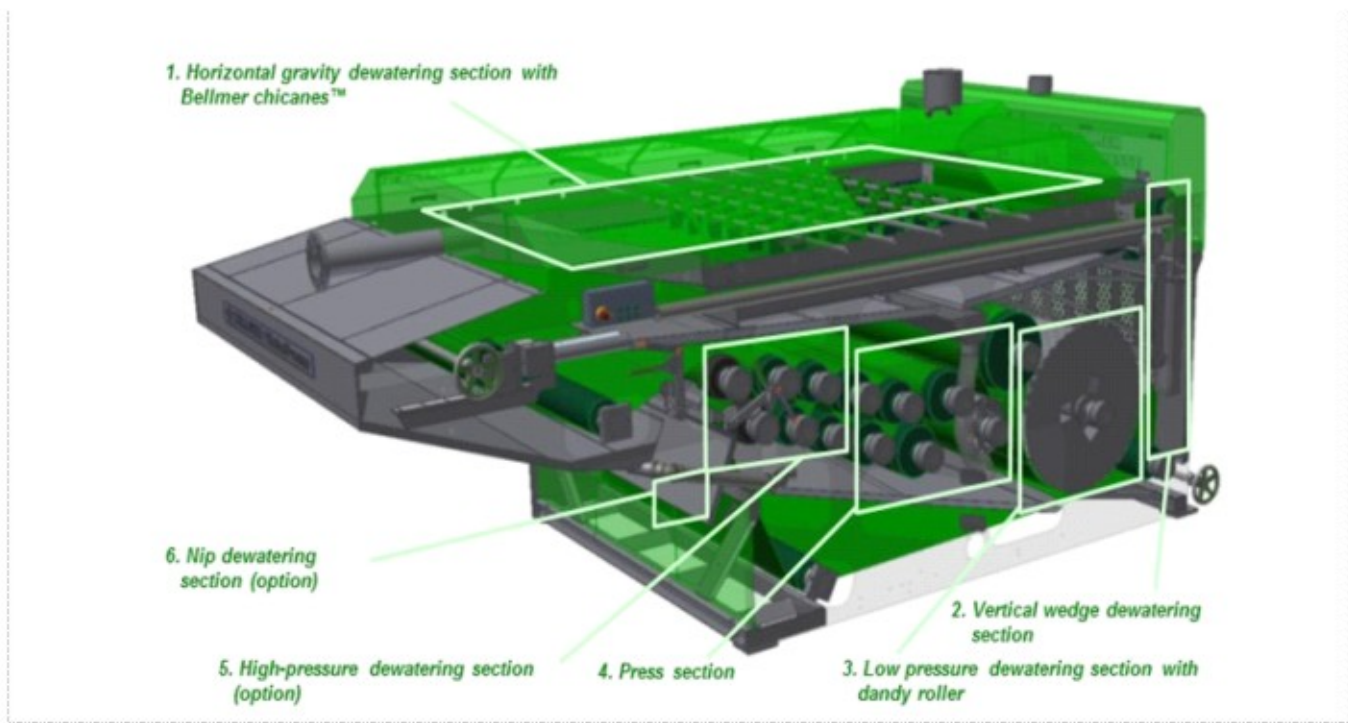


Picture 6 – Different dryness achievable with different screw press technologies

This graph is showing you the difference of dryness you can achieve with different screw press technologies and that for different materials.

Option 2 - Modern Belt Press “WINKLEPRESS” Technology

The Winklepress WP Green 4I, is a belt press developed for highest dryness with different sludges. The special construction of the Winklepress allows to press on one side very “weak” sludge, like biological sludge, and on the other hand very shear-stable sludge like deinking sludge. Naturally, a combination of the different sludge types. The unique construction of the Winklepress merged in one machine very long pre-dewatering press section (important for weak biological sludge) and high pressure section (for press stable sludge). With up to 6 press stages the Winklepress guarantees highest dry solid content even with difficult types sludge.



Picture 7 - Bellmer Winklepress functional description

The combination of the pre-dewatering (Turbodrain) and the dewatering process (Winklepress) finally and ultimately leads to the best result. This means: highest dry solids with good filtrate quality combined with low polymer consumption. The arrangement of the Turbodrain and Winklepress called Cascade.

Due to best results in final dry solids combined with low polymer consumption

there are still further advantages of the Cascade, compared to other dewatering units. Two machines, each unique for its process, - Turbodrain for thickening

Winklepress for dewatering – can always operate at the optimum.

After the thickening the sludge falls down by gravity to the Winklepress and the dewatering process can start. No further pump is required, (energy costs) the sludge floc will not be destroyed, (low polymer consumption). And finally the filtrate of the Turbodrain can be used for the shower pipe of the Winklepress.

II. Case Studies (WINKLEPRESS SOLUTIONS)

1) At the paper mill IPAPPM every year a huge amount of low dewatered sludge have to be collected and disposed. This is very expensive and do not conserve resources. IPAPPM wants to avoid this great amount of sludge and is looking for a way to conserve resources and finally money.

III. Solution

At the paper mill IPAPPM in Andhra Pradesh the mixed sludge can be reduced from around 82.000 t/y with old dewatering equipment to 39.000 t/yr, with the new dewatering equipment from Bellmer, this is a reduction of more than 52 %

	existing	Bellmer	Dim.
amount of sludge	16.425	16.425	tDS/y
solid content after dewatering	20	42	%
sludge amount after dewatering	82.125	39.107	t/y
ash content	38,5	38,5	%

table 1: sludge situation after dewatering

Finally the dewatered sludge is dry enough to boil directly. The energy which is obtained from the combustion is net 110.000.000 MJ/y. For better and easier understanding, this amount of energy corresponds to approx. 210 trucks with hard coal.

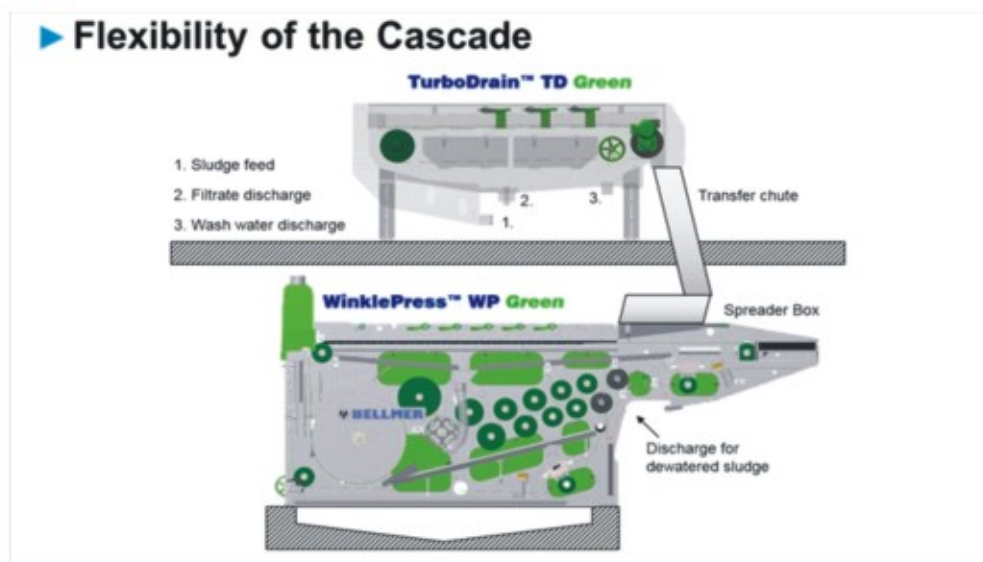
At the IPAPPM the biological, primary and white sludge from the waste water treatment plant and production was dewatered with two belt presses. The belt presses achieve a dewatering result of approx. 20 %. This dewatered sludge is used for landfill or disposal. The sludge is rather wet and during transportation water is still running out the truck.

The sludge is neither good for landfill nor for disposal for both applications the sludge is still too wet, and the high content of water causes high transportation costs.

This situation was very unsatisfying for IPAPPM.

So IPAPPM was searching for a solution with much higher dryness and as a further result reduced transport costs. However, the final aim was to reduce the amount of the sludge to a minimum. The total attainable minimum is the ash content. This means the sludge must be burned. IPAPPM carries out different tests about sludge burning. The result of the tests was: a dryness of >40 % is required to burn the sludge directly in the boiler without further drying. If this condition is fulfilled, with the boiling it is possible to win energy. And the transportation cost for the sludge can still be reduced because only the ash remains for the transport. This will be an advantage too. The yield of energy during burning is higher than the energy consumption for heating up the mixture of water and sludge and the evaporation for the water. So IPAPPM have decided to choose this way. The most important precondition for this is, to find a dewatering machine which is able to guarantee a dryness of 40 % and more with the existing sludge composition.

After extensive studies IPAPPM have decided to invite Bellmer, a sludge dewatering specialist from Germany to present a solution. Bellmer carried out complex tests in the Bellmer Lab and onsite at APPM with the existing sludge. After the tests Bellmer can present a solution for this challenge



Picture 8 – Bellmer Cascade

Why the customer prefers a Cascade from Bellmer

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IV. Conclusion

Conserve resources like water and energy is very important. To avoid or minimize waste is very important to save costs. The famous paper mill IPAPPM decides together with their deliverer Bellmer to go new way by the sludge dewatering result: the amount of sludge for disposal can be reduced to less than 1/10 of the initial volume. As a benefit energy of around 210 truck coal per year can be saved. All together in total more than 1 Million EUR/y less costs.

	existing	Bellmer	Dim.
amount of sludge	82.125	./.	t/y
amount of ash	./.	6.323	t/y
number of truck loading	6.840	525	1/a

Table 2: Economy with Bellmer saving

	existing	Bellmer	Dim.
total energy content:	./.	165,000,000	MJ/y
consumption for heating evaporation	./.	55,000,000	MJ/y
energy for use	./.	110,000,000	MJ/y
number of truck loading	315		1/a

Table 3: Economy with Bellmer by sludge burning

	existing	Bellmer	Dim.
number of truck loading for waste	6,840	525	1/a
number of truck loading for coal	315	./.	1/a
number of truck loading total	7,155	525	1/a
saving of truck loading with Bellmer		> 90	%

Table 4: Economy with Bellmer total

II. Case Studies (SCREW PRESS SOLUTIONS)

I wish to introduce you to three different applications here in India.

Case Study India



Century Pulp and Paper:

Dewatering of Primary Clarifier Sludge from ETP

Furnish: Virgin Pulp, Waste Paper and Bagasse

2 Lines with 32 bdmtpd each at 1 % inlet consistency with around 46 % ash

Guaranteed final dryness: not below 60 %.

Case Study India



Naini Tissue:

Dewatering of Primary Sludge

Furnish: from 100 % bagasse to 100 % wheat straw

30 bdmtpd at 1 % inlet consistency with around 17 % ash

Guaranteed final dryness: not below 52 %.

Case Study India



Khanna Paper:

Dewatering of DIP and Primary Sludge coming from clarifiers and pre-dewatered by gravity table

Furnish: Waste Paper

Up to 132 bdmtpd at 20 % inlet consistency with around 65 % ash
Biological Sludge Ratio: 2 %

Guaranteed final dryness: not below 55 %.

VIII. Other References

There exist more than 400 installations worldwide and for sludge dewatering only the new technology is being applied today because of the high dryness values which is the most important criteria in sludge dewatering. But it is not limited to sludge dewatering alone which we can see in my last picture now showing a reference project in Germany which was executed on a turn-key basis.

Technical data and key figures of a reference plant

Liner machine 10.1 m, 1,900 m/min

650,000 t/a papers for corrugated boards from 100% WP

BKM rejects treatment system

200 BDMT/D coarse rejects to 70% cake dryness

100 BDMT/D fine rejects (sludge) to 64 – 68% cake dryness

Demands and requirements on Refuse Derived Fuels (RDF)

- Separation of non-combustible material glass, sand, metal
 - Metal parts ferrous metals < 1%,
 - Metal parts non-ferrous metals < 1%.
 - Dry content $\geq 65\%$,
- Screening diameter 90mm (e.g. edge length coarse rejects < 100x50x20mm (or alternatively 200x50x25mm)),
- And, where applicable, NEW: proportion of PVC < 1%,

Disposal and use of the dewatered rejects as 100% secondary fuel and that "just in time"

