

**Kolkata Unit
completed its 40 years of
operation
& is proud to be part
of KHD Humboldt Wedag
on completion of its 150 years of
operation**

BENEFICIATION OF INDIAN NON COKING COAL - ISSUES, PROBLEMS & REMEDIES

**Gurudas Mustafi,
Vice President, Humboldt Wedag India Pvt. Ltd.
Kolkata, India**

Beneficiation of Lump Sized Coal

Issues

A great percentage of the power station coal mined throughout India has been burned so far without preparation or refuse separation, because the preparation costs are too high or combustible substance is lost in the preparation process. Considering, however, the lower wear in the boiler houses and the increased volume of transportation in the case of prior separation of refuse from the power station coal, then a preparation, at least of the lump sized portion should be profitable. Test regarding the abrasive properties of different types of coal shows that the abrasion and thus the wear are considerably limited due to a separation of refuse from lumpy run-of-mine coal.

Benefits

The removal of a certain portion of the refuse from the uncrushed raw coal offers great advantages for the preparation process, such as for example

- Decrease of power requirements for size reduction.
- Increased yield of graded coal in the case of domestic coal production,
- decreased yield of slurry,
- decrease of ash content in the raw slurry,
- more favourable homogenising properties of the raw coal,
- decreased wear in the concentration machines,
- more favourable utilisation of the preparation capacity, i.e. increased efficiency of the preparation plant.

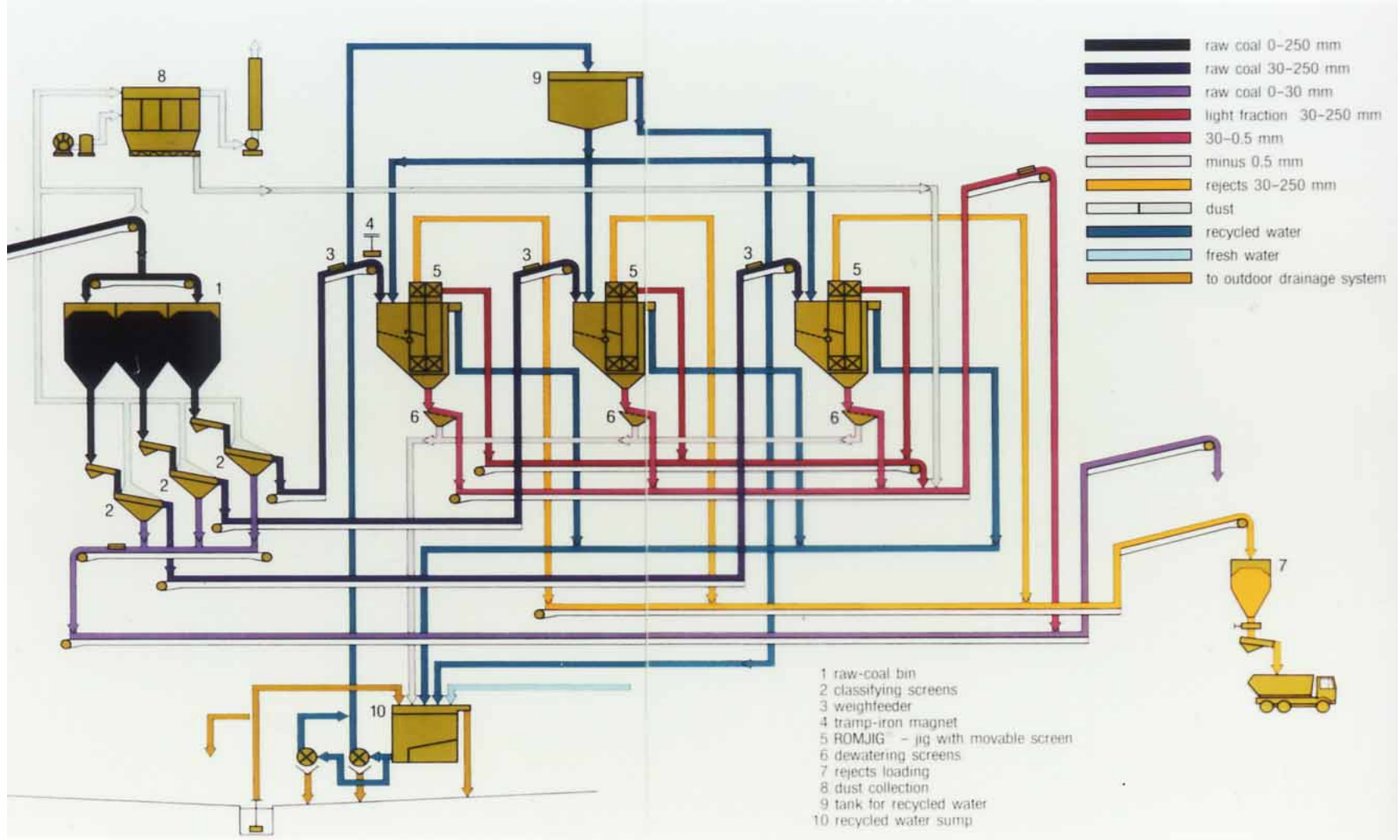
Remedies

The development of the ROMJIG (Fig 1) opened the possibility, to use a very simple process for the beneficiation of the lump size coal - the top size is 400 mm and the bottom feed size is 30 mm - by using only one technologically improved machine and some standard auxiliary equipment.

In fact the idea was to solve the problem of preparing non coking coal, as far as possible dry.

After many years of development, such plants have been installed at Bina and Kargali and are in operation to separate refuse and clean coal. (Ref : Flow Sheet 1)

Bina / India: Deshaling in front of a Powerplant **ROMJIG**



Flow Sheet 1: ROMJIG Process for Run of Mine Coal

Separation

ROMJIG

for separation of coal 30 - 400 mm

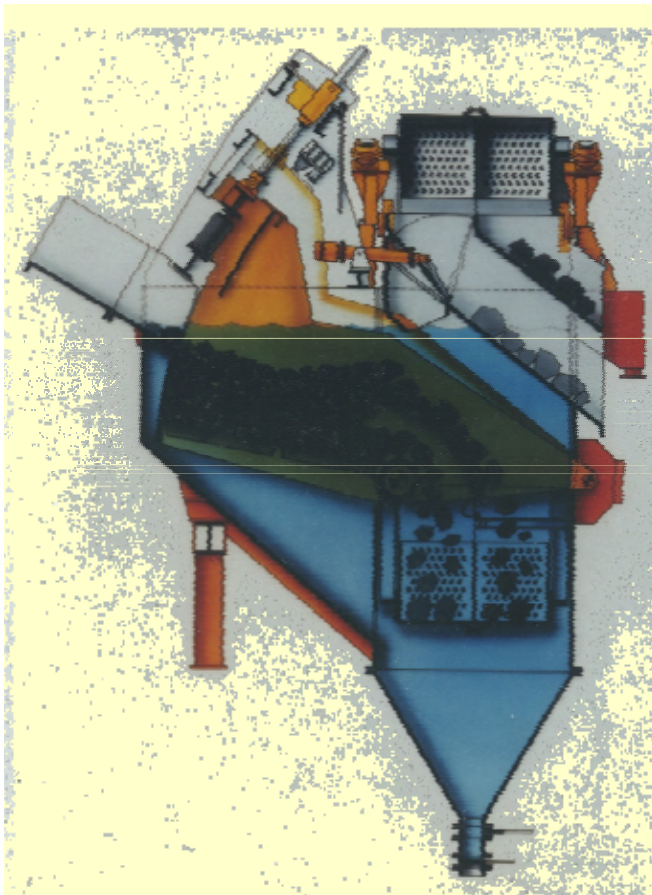


Fig 1: ROMJIG

Results

BINA

Presently from this plant of NCL washed coal is produced with ash < 34% and is linked to Delhi Vidyut Board. In general the results are:

Raw Coal Screen analysis:

<u>Grain size</u>	<u>Wt. %</u>	<u>Ash %</u>
250 - 30 mm	68.78	42.13
30 - 0 mm	31.22	38.08
250 - 0 mm	100.0	40.87

Products of that plant:

<u>Product</u>	<u>Wt. %</u>	<u>Ash %</u>
deshaled coal	49.76	31.34
unwashed coal	31.22	38.08
saleable product	80.98	33.94
Refuse	19.02	70.37

KARGALI

During the performance tests conducted over a span of 15 days a series of tests were conducted and following results were computed on an average basis:

Raw Coal Screen analysis:

<u>Grain size</u>	<u>Wt. %</u>	<u>Ash %</u>
350 - 50 mm	45.3	40.75
50 - 0 mm	54.7	32.56
350 - 0 mm	100.0	36.27

Products of that plant:

<u>Product</u>	<u>Wt. %</u>	<u>Ash %</u>
deshaled coal	34.26	30.7
unwashed coal	54.7	32.56
saleable product	88.96	31.84
Refuse	11.04	71.96

At a cut density of 1.9, the average imperfection determined was 0.089

Prospects

The successful employment of a ROMJIG for large refuse separation of run-of-mine coal opens a wide field of future applications. In view of the favourable secondary conditions, such as low water and power consumption, low expenditure for necessary auxiliary equipment this process stands any time economical compared with other proven technologies of large refuse separation and is the ideal process, in case people think of a pit head instalment.

Beneficiation of coarse grain coal

Issues

Whenever the characteristics of the raw coal does not allow, to achieve the required product quality with the ROMJIG by only washing the lump size coal, the grain size of beneficiation has to be reduced. Reasons can be the grain size distribution, when the amount of material < 30 mm is more and the ash content of this fraction too high.

Remedies

This leads immediately to the beneficiation of coarse coal by means of Batac[®] Jig (Fig 2) or Heavy Media Teska[®] Separator / Heavy Media Bath (Fig 3).

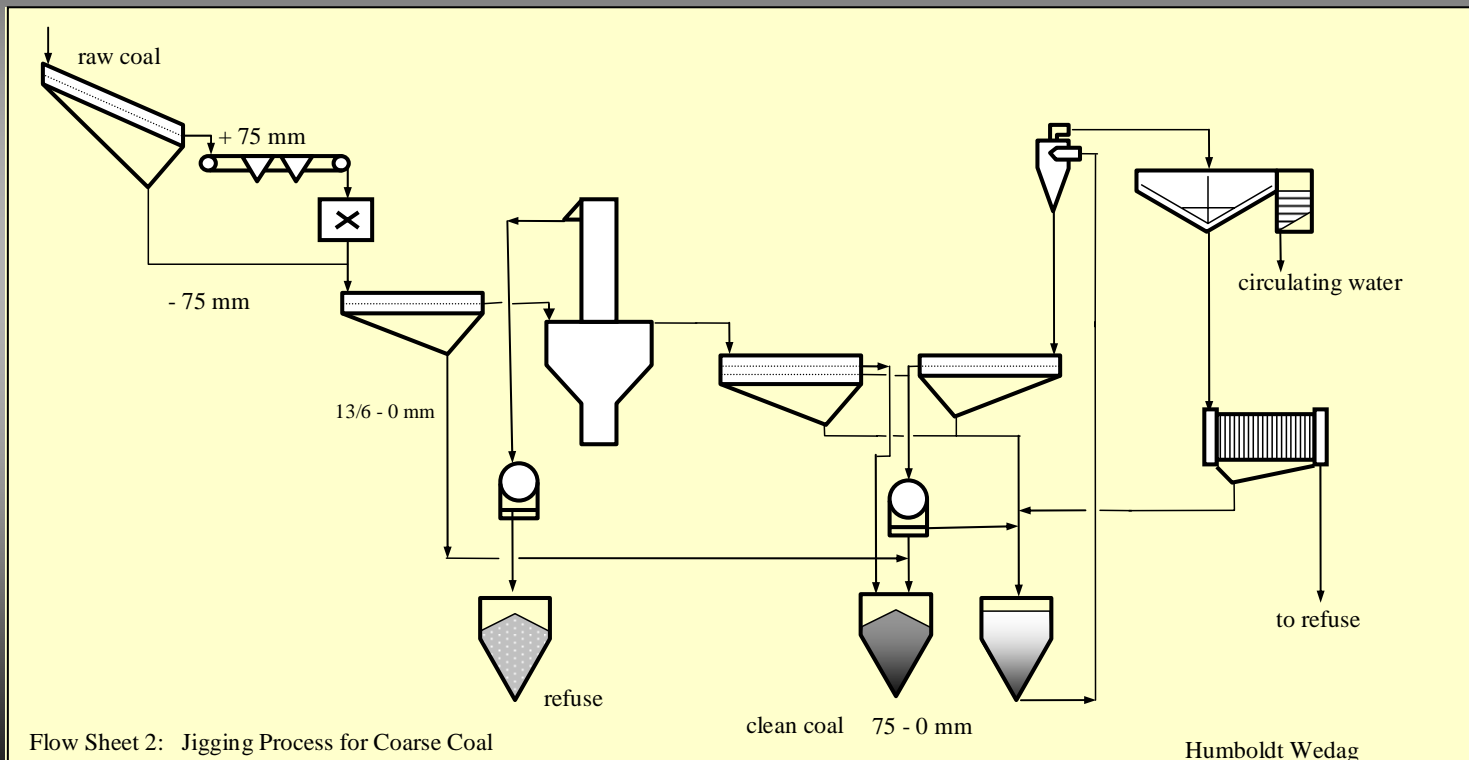
A typical process for such a jig plant requires only very few equipment while some additional equipment and the magnetite circuit essentially comprising of magnetizer, primary & secondary magnetic separators and de-magnetizer are involved in such a HM Separator / Bath plant. The raw coal with a top size of 75 (100) mm is at first screened at 13 / 6 mm. The coarse product 75 (100) – 13 / 6 mm is fed either to the Batac jig or Heavy Media Teska Separator / H.M.Bath, where it is separated into refuse and clean coal and un-washed fraction (-) 13 / 6 mm mixed with Clean Coal. (Ref : Flow Sheets 2 & 3)

The process is closed by means of a combination of cyclones, filters & thickener (Ref : Flow Sheets 5 or 8)

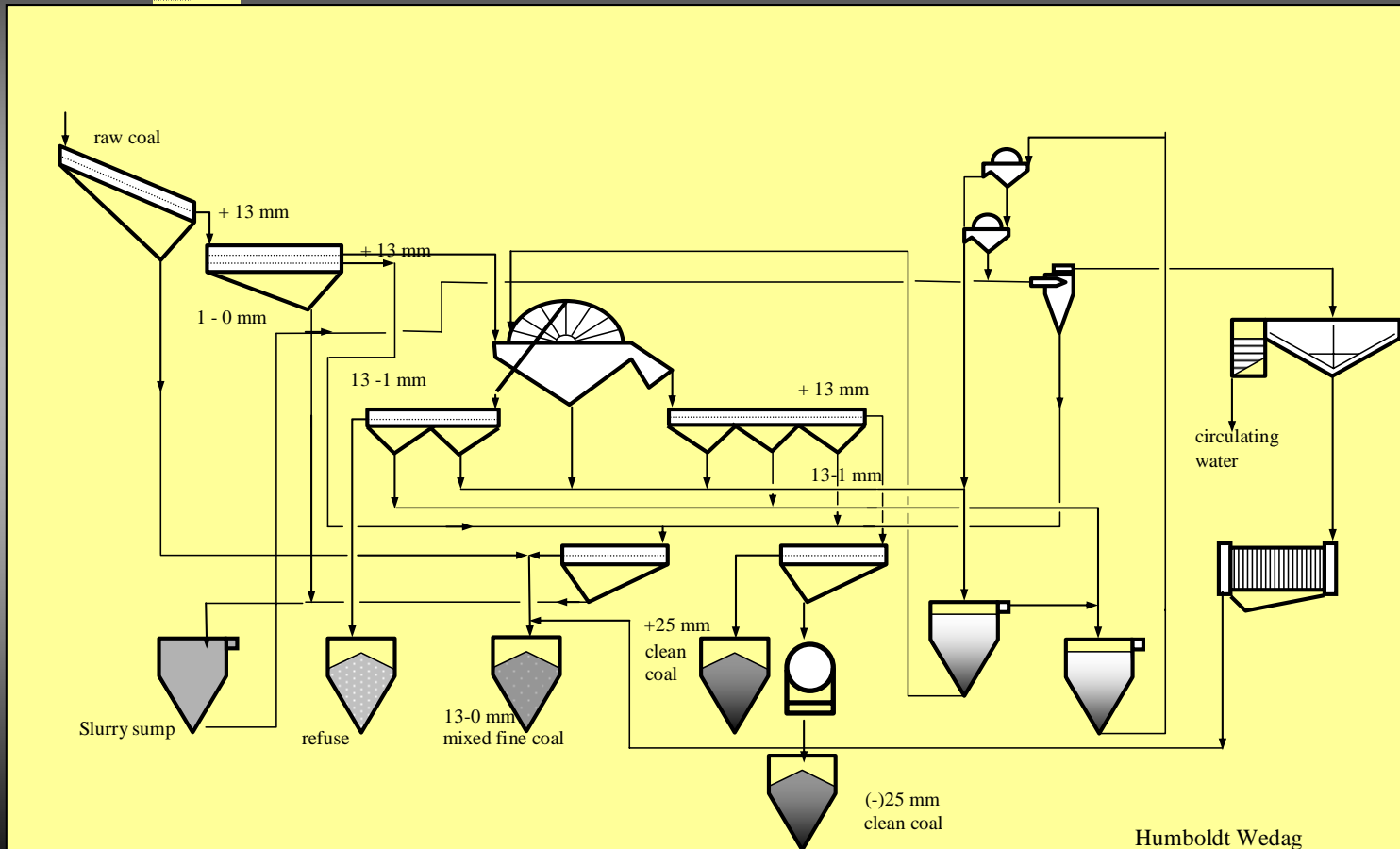
The top size can be reduced to 50 mm depending on the grain size distribution.

Standard-Flowsheet

Jigging process for Power Station Coal



Standard-Flowsheet Heavy Medium for Power Station Coal



Flow Sheet 3: Heavy Medium Process for Coarse Coal

Humboldt Wedag

Separation

Coarse Coal BATAAC - JIG
for separation of coal 10 - 150 mm

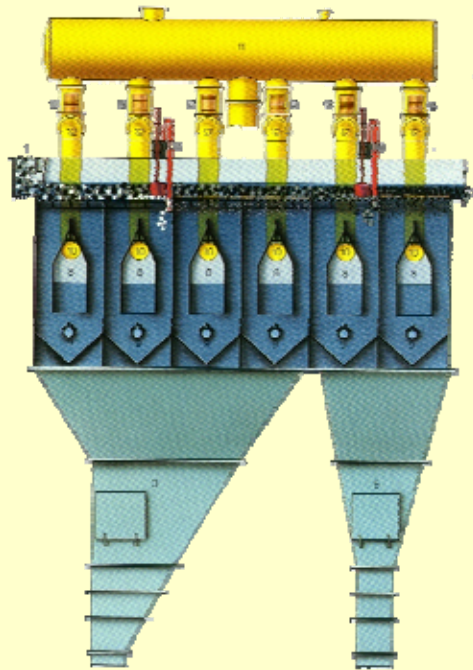


Fig 2: Batac Jig



Separation

TESKA - Separator

Heavy Medium separation 10 - 150 mm

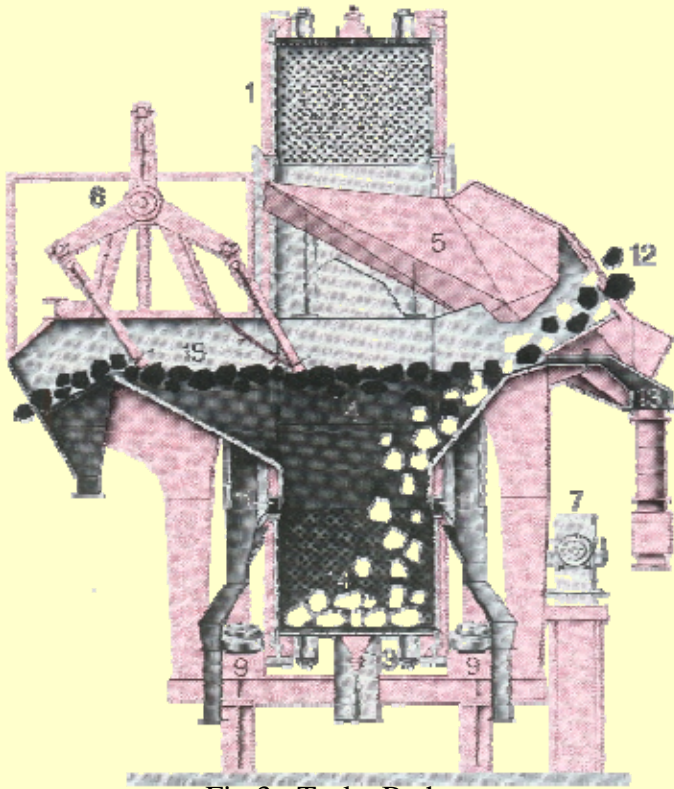


Fig 3: Teska Bath



Prospects

The Batac jig is so flexible that the bottom washing size can be reduced from 13 mm to 6 mm or even to 3 mm, without a modification of the flow sheet. The only problem is the dry screening at the lower sizes, which can be solved by using the right screening system.

Equally good operating results are achieved with the Heavy Media Teska Separator / H.M.Bath without reducing the lower size and for which it needs to be ensured that the media recovery circuit is properly designed and media of the correct quality & quantity is made available.

Results

PIPARWAR

Piparwar washery under Central Coalfields Limited having a capacity of 6.5 mtpa is equipped with two such Batac Jigs, which forms the heart of the plant supplying washed coal of around 82 to 83% yield having ash < 34% to NTPC for their Delhi based power plants. Raw coal presently fed has an ash in the range of 39 to 40%

PRIVATE WASHERIES

Plants with Jig and HM Bath for similar application have been set up for private entrepreneurs to wash power grade coal in different locations adjacent to MCL, SECL & WCL mines. Some of these are already in operation. (Results attached) Additionally the depth of beneficiation can be increased by adopting further processes, like the combination of coarse and fine coal jigging or combination of coarse coal HM Bath and fine coal HM Cyclone or combination of jigging with heavy media process and at the end the addition of the flotation system, which is relatively seldom in the beneficiation of non coking coal.

Results

The ash in raw coal received varies between 34 to 38%. Results shown in both cases are with 38% ash in raw coal but from different mines of WCL.

HEAVY MEDIA BATH

The results from a plant installed at Wani supplying washed coal to MSEB are:

Raw Coal Screen analysis:

<u>Grain size</u>	<u>Wt. %</u>	<u>Ash %</u>
50 - 13 mm	68.00	37.80
13 - 0 mm	32.00	40.00
50 - 0 mm	100.00	38.50

Products of that plant:

<u>Product</u>	<u>Wt. %</u>	<u>Ash %</u>
washed coal	41.00	24.10
unwashed coal	32.00	40.00
saleable product	73.00	31.07
Refuse	27.00	58.60

Operating Cut Density : 1.45

BATAC JIG

The results from a plant installed at Ghugus supplying washed coal to MSEB are:

Raw Coal Screen analysis:

<u>Grain size</u>	<u>Wt. %</u>	<u>Ash %</u>
50 - 6 mm	85.0	37.90
6 - 0 mm	15.0	38.13
50 - 0 mm	100.0	37.93

Products of that plant:

<u>Product</u>	<u>Wt. %</u>	<u>Ash %</u>
washed coal	49.80	24.60
unwashed coal	15.00	38.13
saleable product	64.80	27.73
Refuse	35.20	56.71

Operating Cut Density : 1.5

Beneficiation of medium and fine grain coal

Issues

In good coal reserves - preferably in open cast mining - a relatively big amount of good quality raw coal is dumped, i.e. wasted, due to the selective mining method.

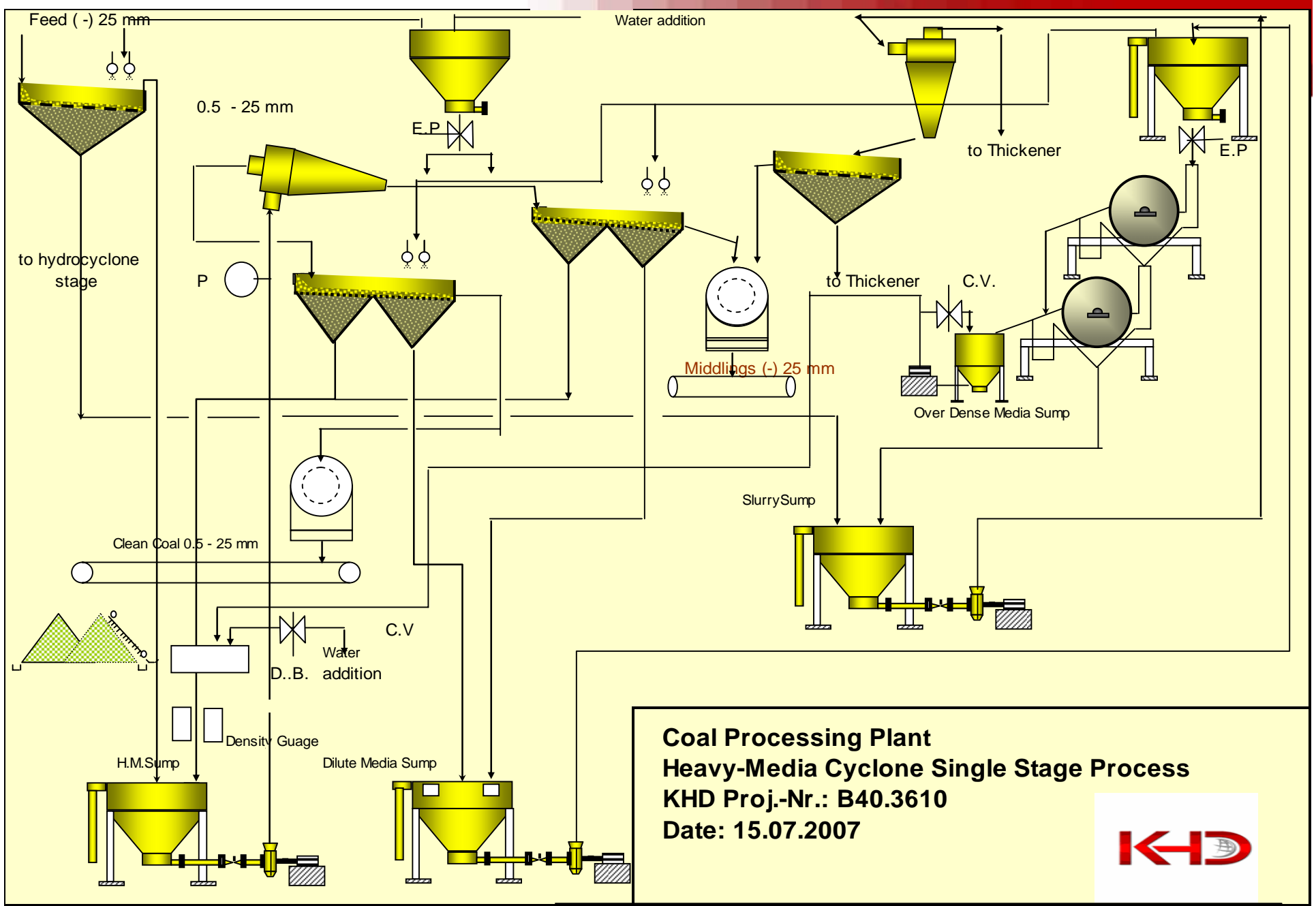
This is the material close to the border between coal seam and shale band, which contains up to 50% of saleable coal.

Further whenever the characteristics of the raw coal does not allow, to achieve the required product quality with only washing the coarse coal, the grain size of beneficiation has to be reduced. Reasons can be the liberation in course of crushing, grain size distribution, presence of amount of material $< 13 / 6$ mm is more and the ash content of the fine material is too high.

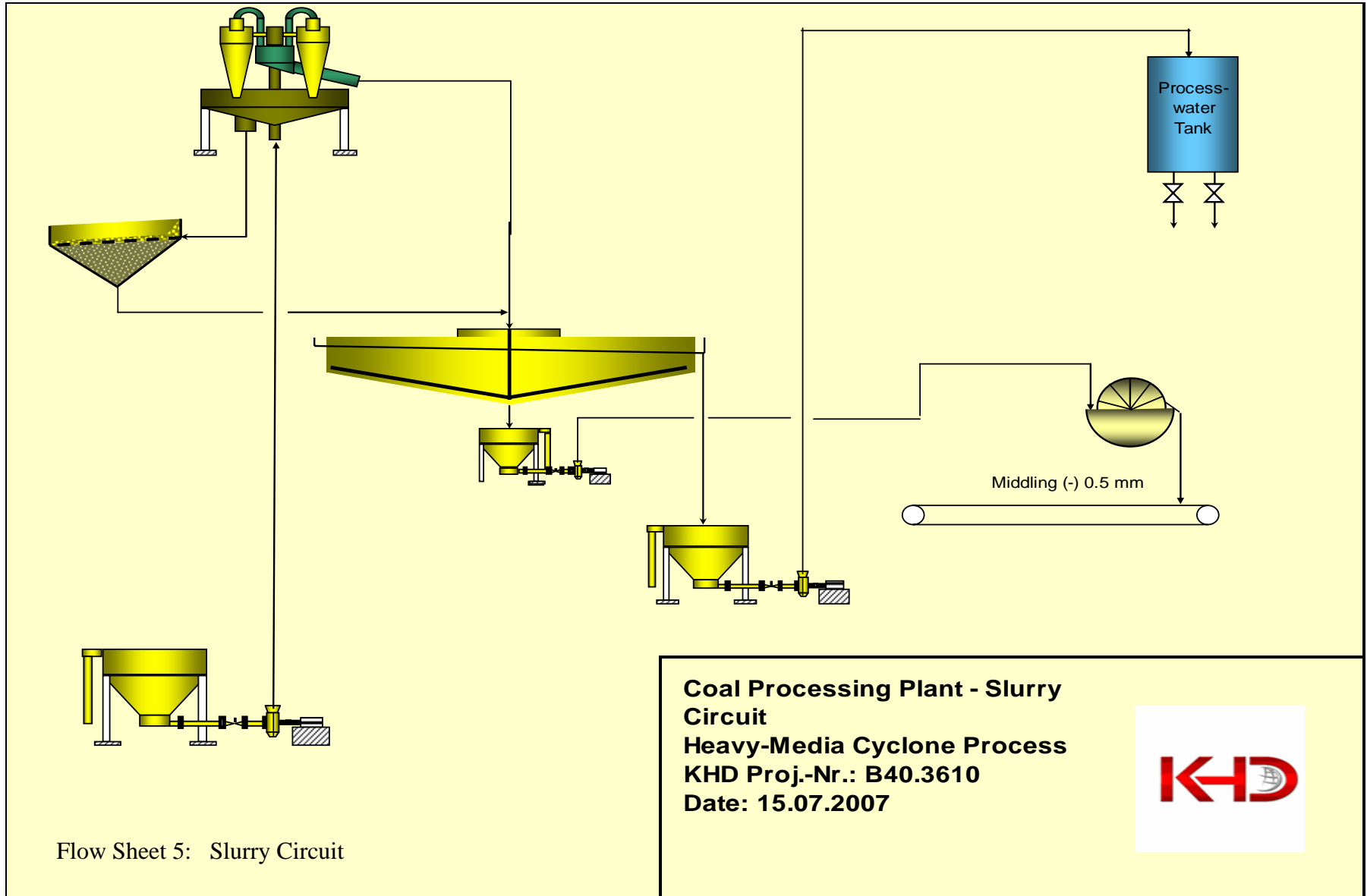
Remedies

This leads immediately to the beneficiation of small coal by means of Heavy Media Cyclones (Fig – 4) or fine coal Batac® Jig (Fig – 5).

World over plants are being installed to process especially such type of interface material. The process flow sheet of such a plant appears very simple. The heart of this plant is the HM Cyclone or Batac jig and depth of beneficiation is again defined by the raw coal characteristics and the product requirements. Due to this the flow sheets of such plants vary widely. Here we present a sample of both systems, which can be considered as a standard for this duty (Ref: Flow Sheets 4,5,6,7 & 8).



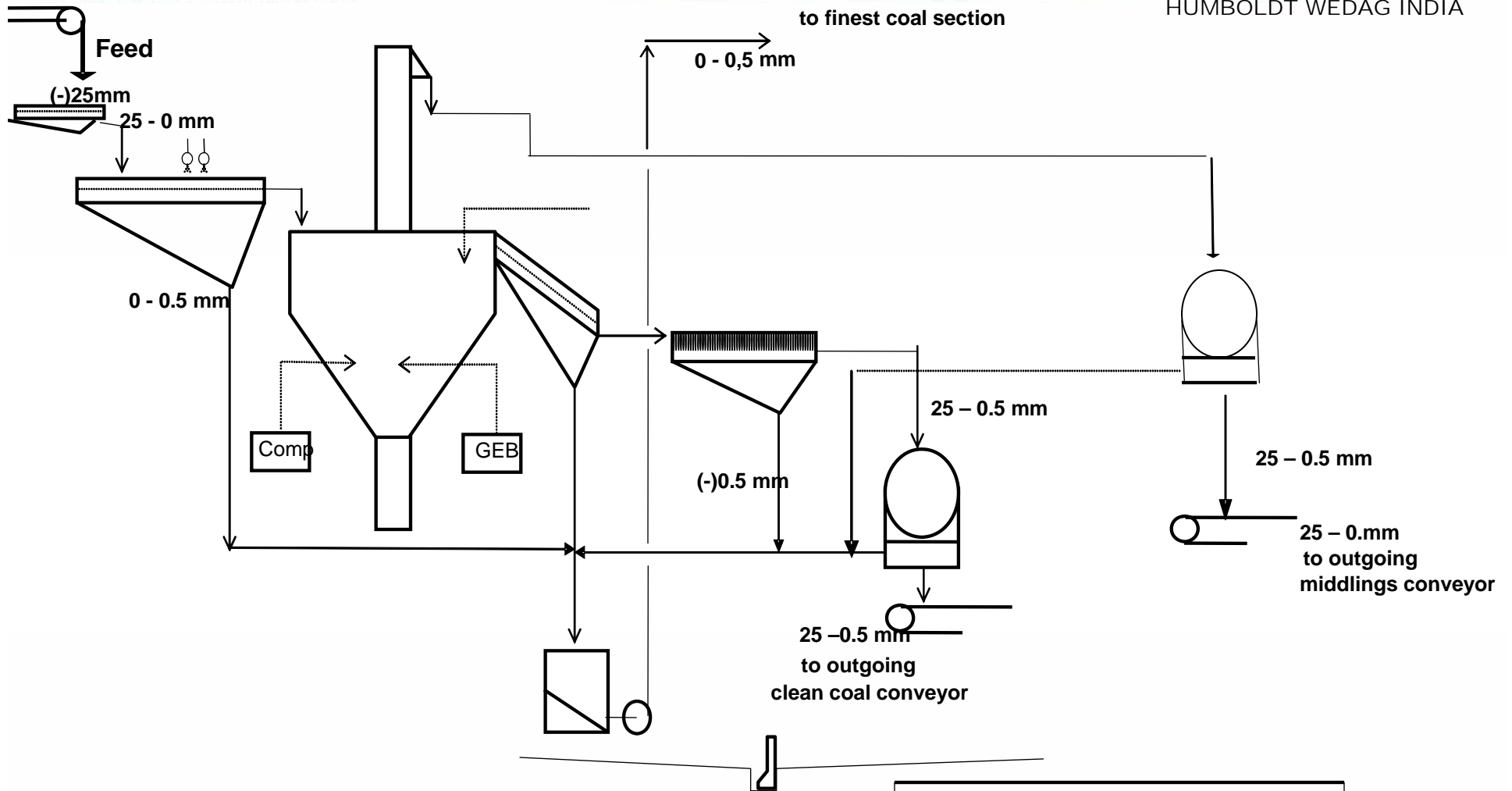
Flow Sheet 4: Heavy Medium Single Stage Cyclone Process for Small Coal



Flow Sheet 5: Slurry Circuit

**Coal Processing Plant - Slurry
Circuit
Heavy-Media Cyclone Process
KHD Proj.-Nr.: B40.3610
Date: 15.07.2007**

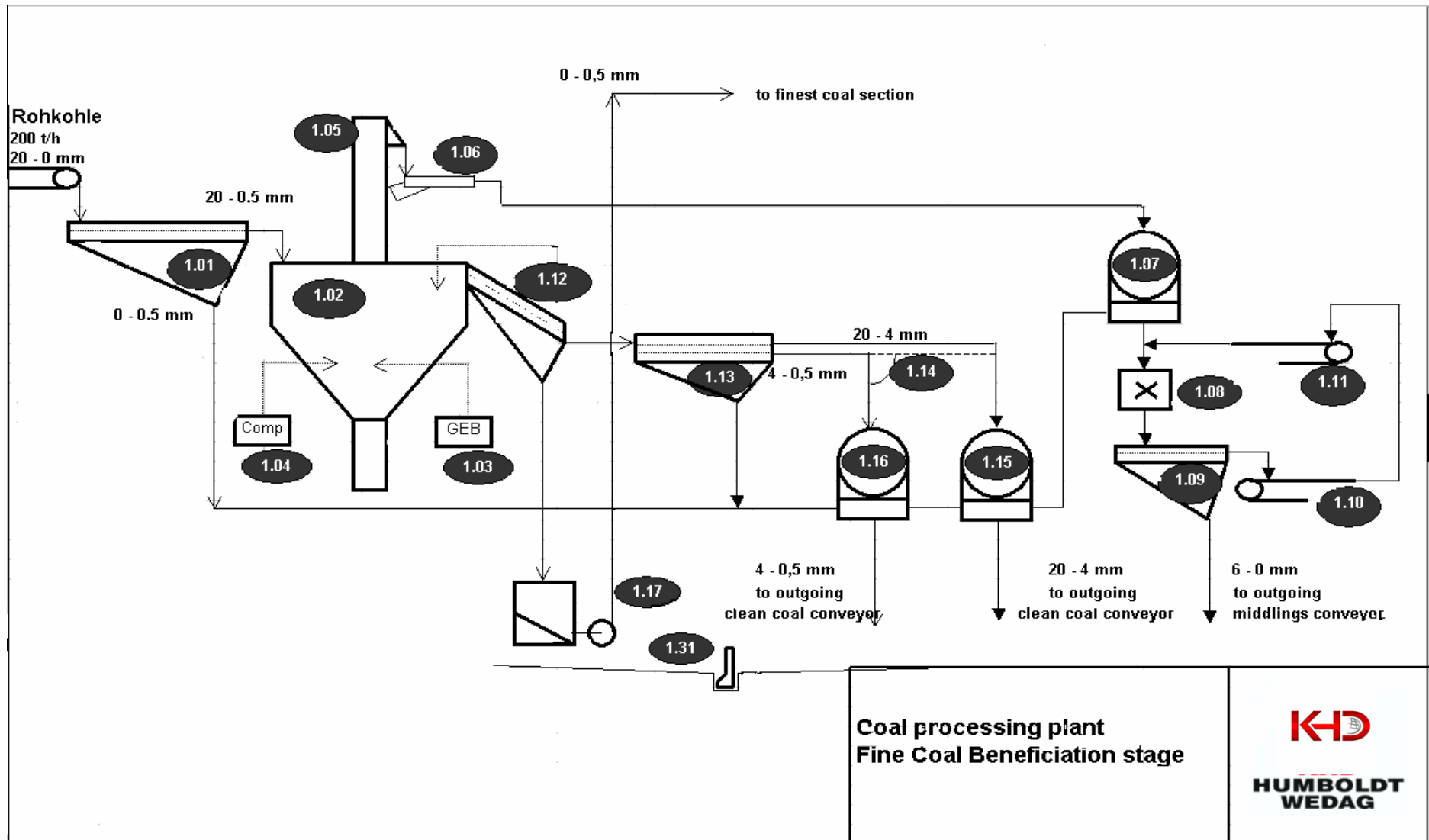




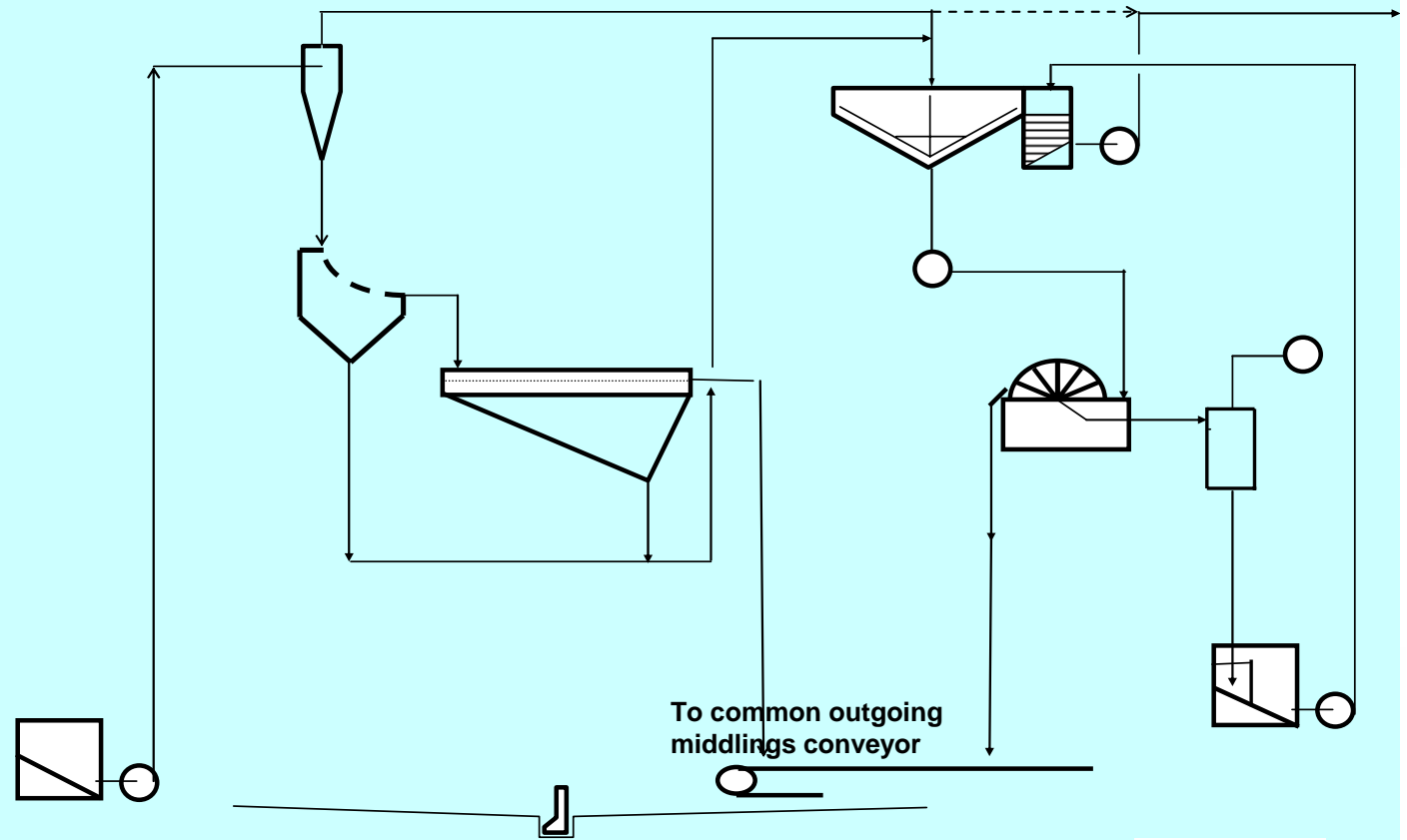
Flow Sheet 6: Batac Jig Single Stage Process for Small Coal

Coal processing plant
Batac Jig Single Stage Process
KHD Proj.-Nr.: B40.3654
Date: 19.07.2007





Flow Sheet 7: Batac Jig Single Stage Process for Small Coal with Crushed Refuse for Power Generation



Coal beneficiation plant
Slurry Circuit
KHD Proj.-Nr.: B40.3654
Date: 19.07.2007



Separation

HMS - Cyclones
for separation of coal 0 - 50 mm



Fig 4: HM Cyclone

Separation

HUMBOLDT WEDAG INDIA

Fine Coal BATAAC - JIG for separation of coal 0 - 20 mm

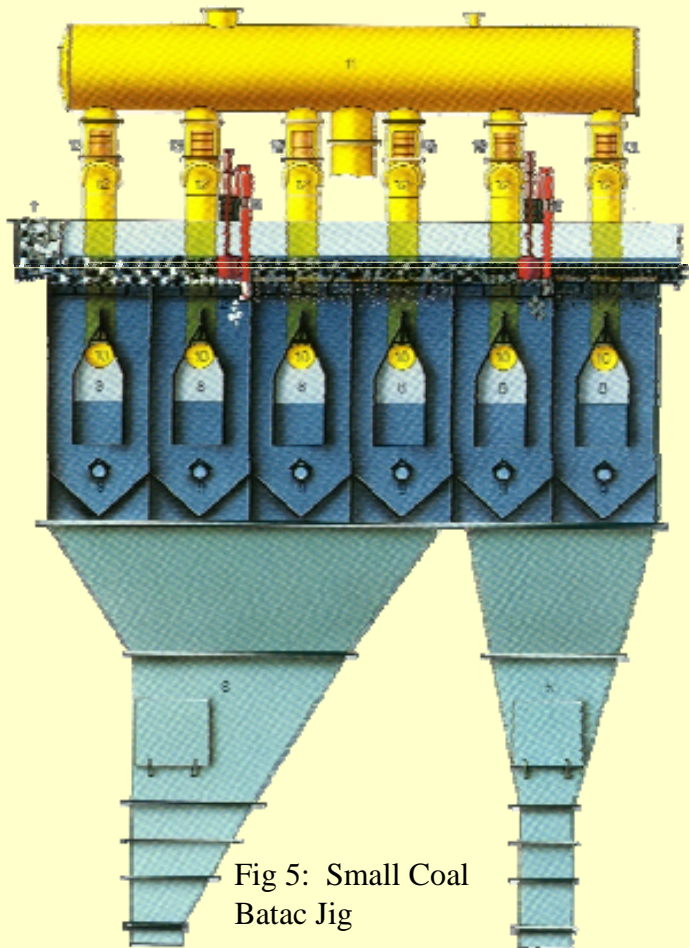
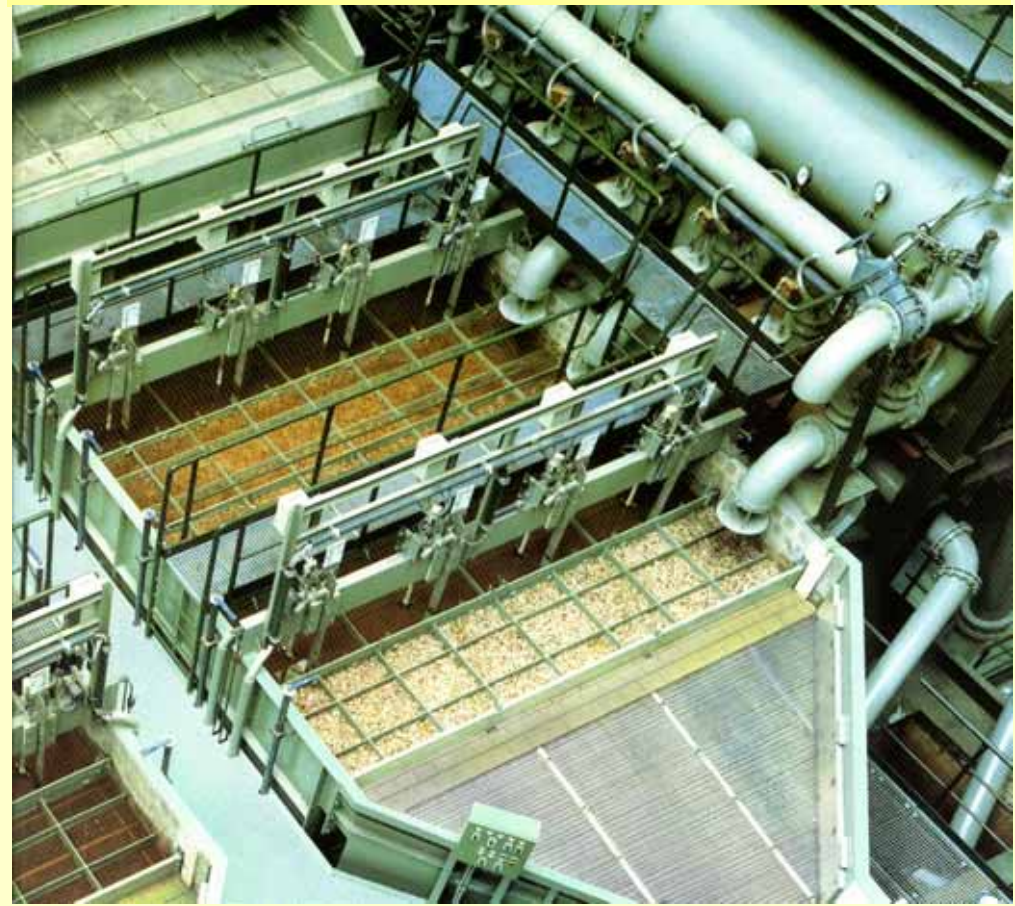


Fig 5: Small Coal
Bataac Jig



Prospects

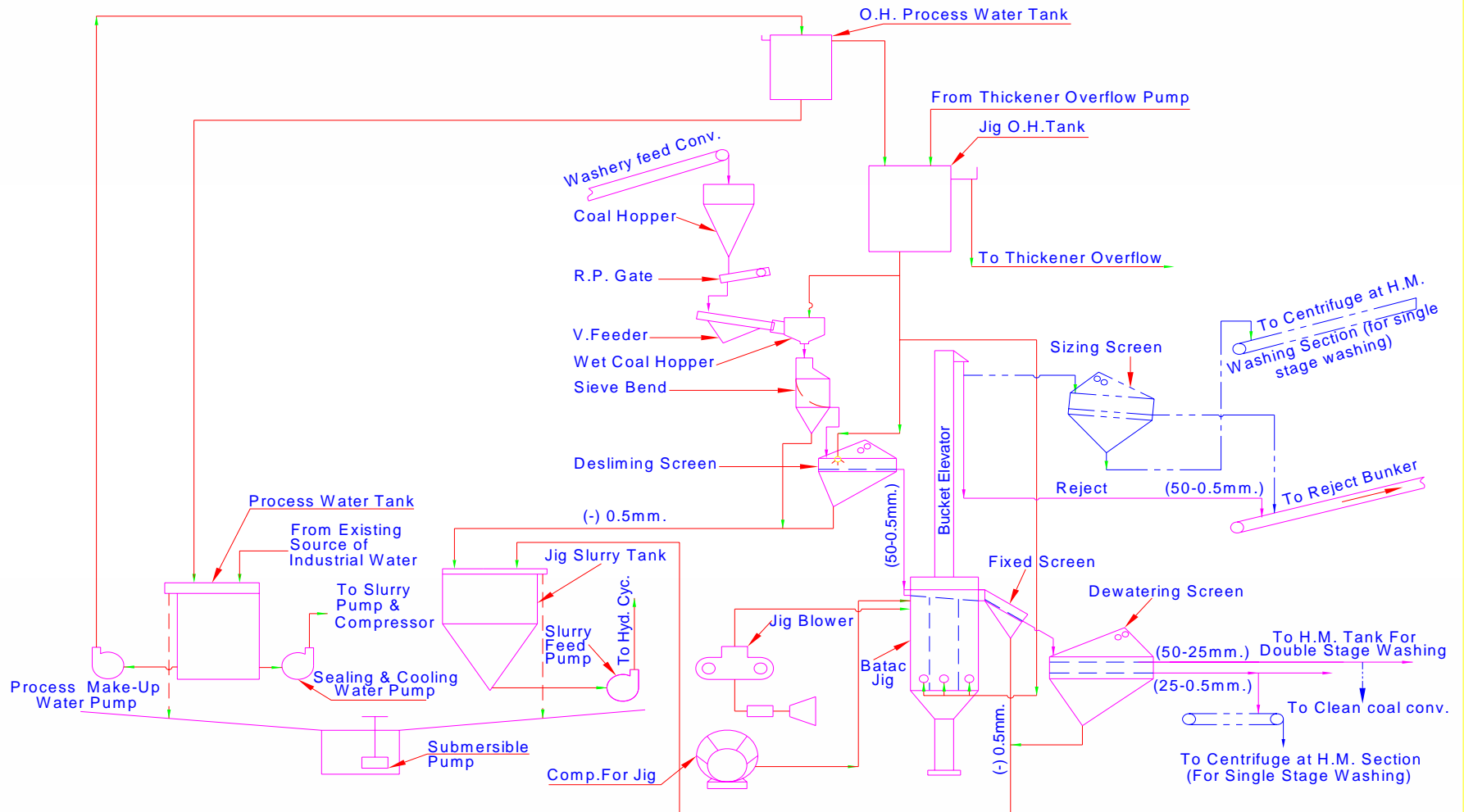
Such plants having a simple designed process can be very useful for producing washed coal required for consumers besides power viz. sponge iron plants, cement plants to name a few.

Results

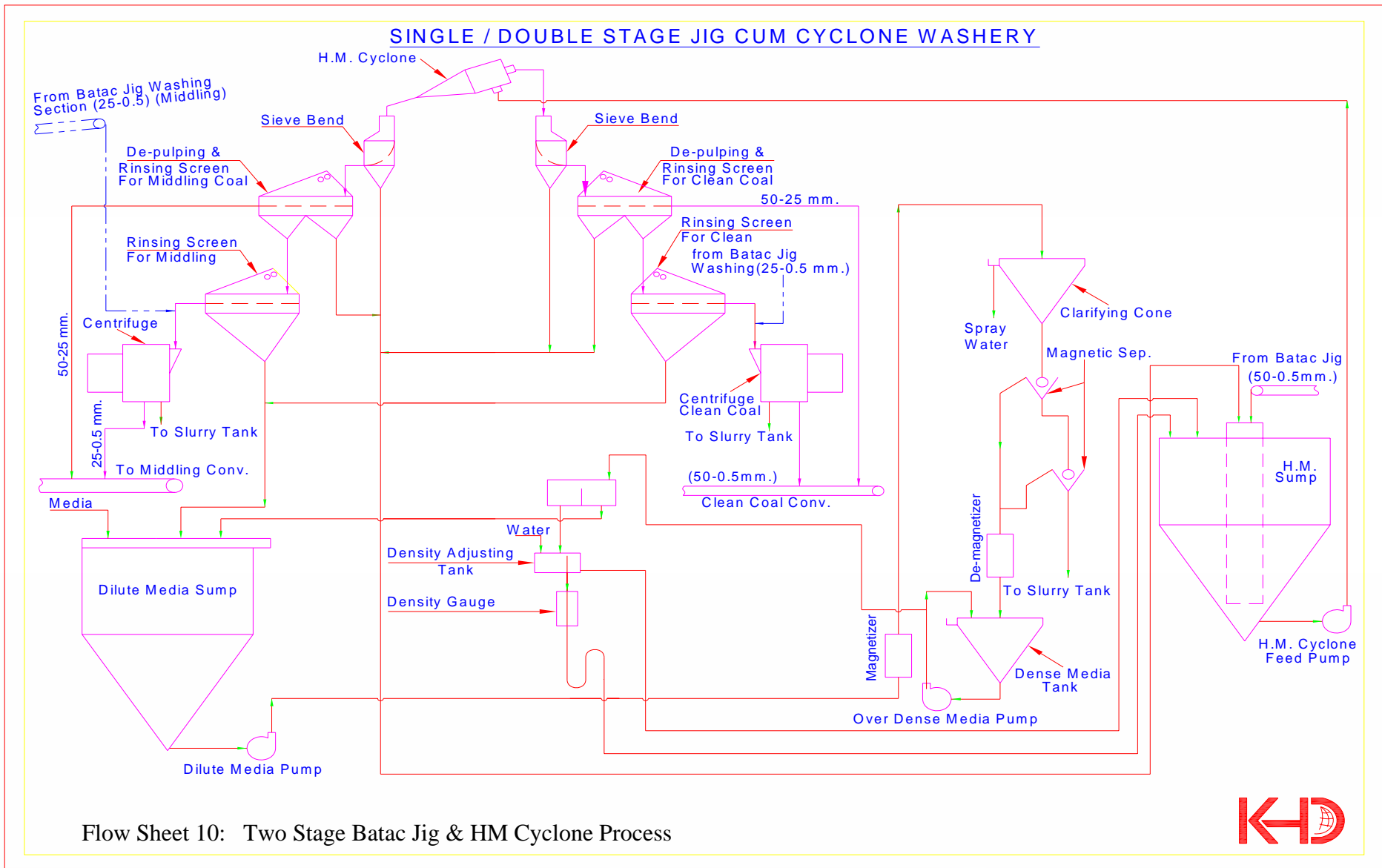
Coal washeries with both Jig and HM Cyclone process are in operation in JSPL, BPSL, BSL, Grasim Cement & Gujarat NRE to name a few while ACC, UltraTech are in the process of setting up their captive coal washeries at different locations which includes 3 product washery with either two stage H.M.Cyclone process (Ref: Flow Sheet 9,10 & 11) or combination of jigging with heavy media process (Ref: Flow Sheet 12 & 13) having provision to operate as and when required one circuit to produce two products.

More are being set up to wash non coking coal in different locations adjacent to WCL, MCL & SECL mines by private entrepreneurs to meet the rising demand of washed coal.

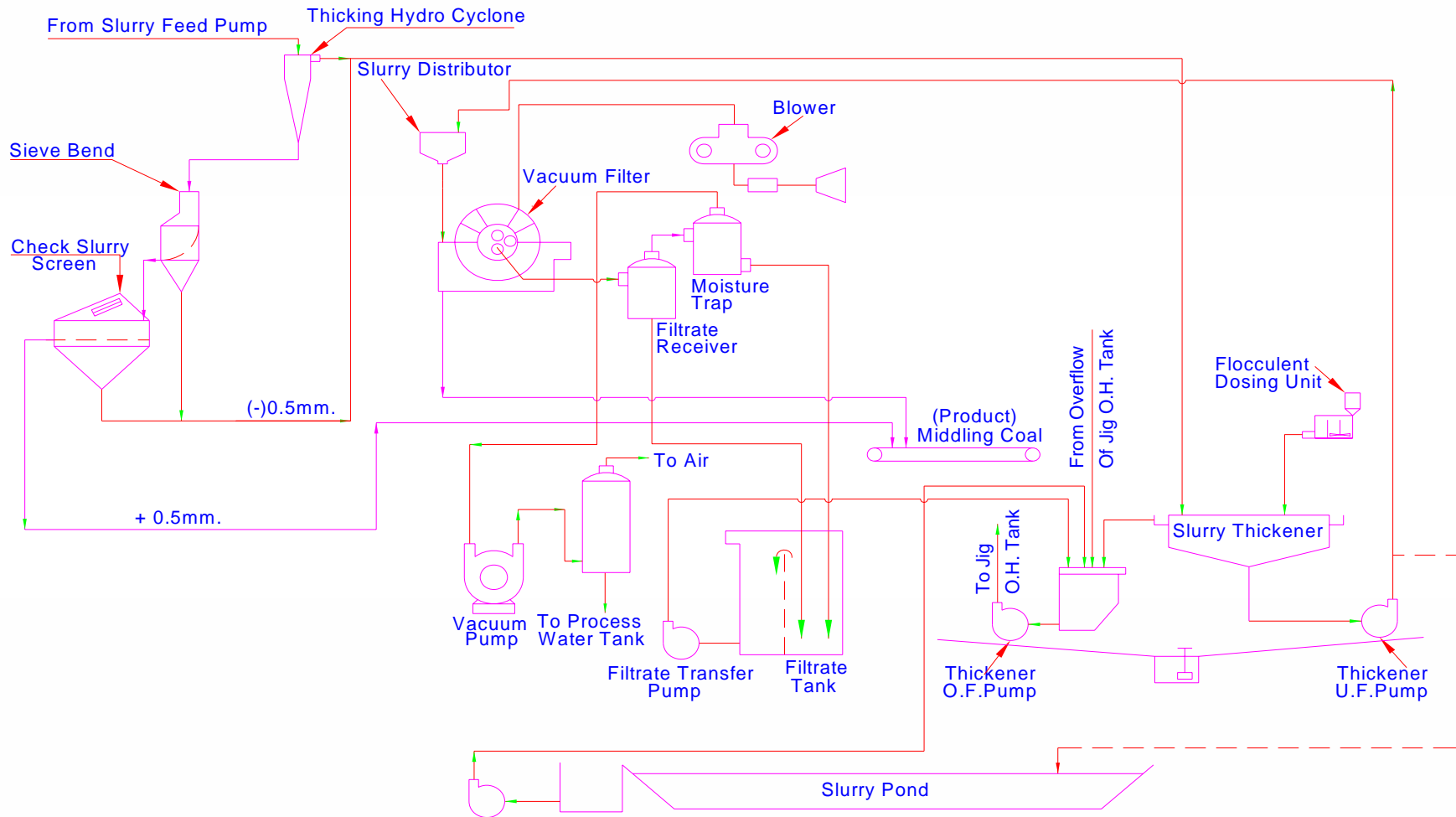
SINGLE / DOUBLE STAGE JIG CUM CYCLONE WASHERY



Flow Sheet 9: Two Stage Batac Jig & HM Cyclone Process

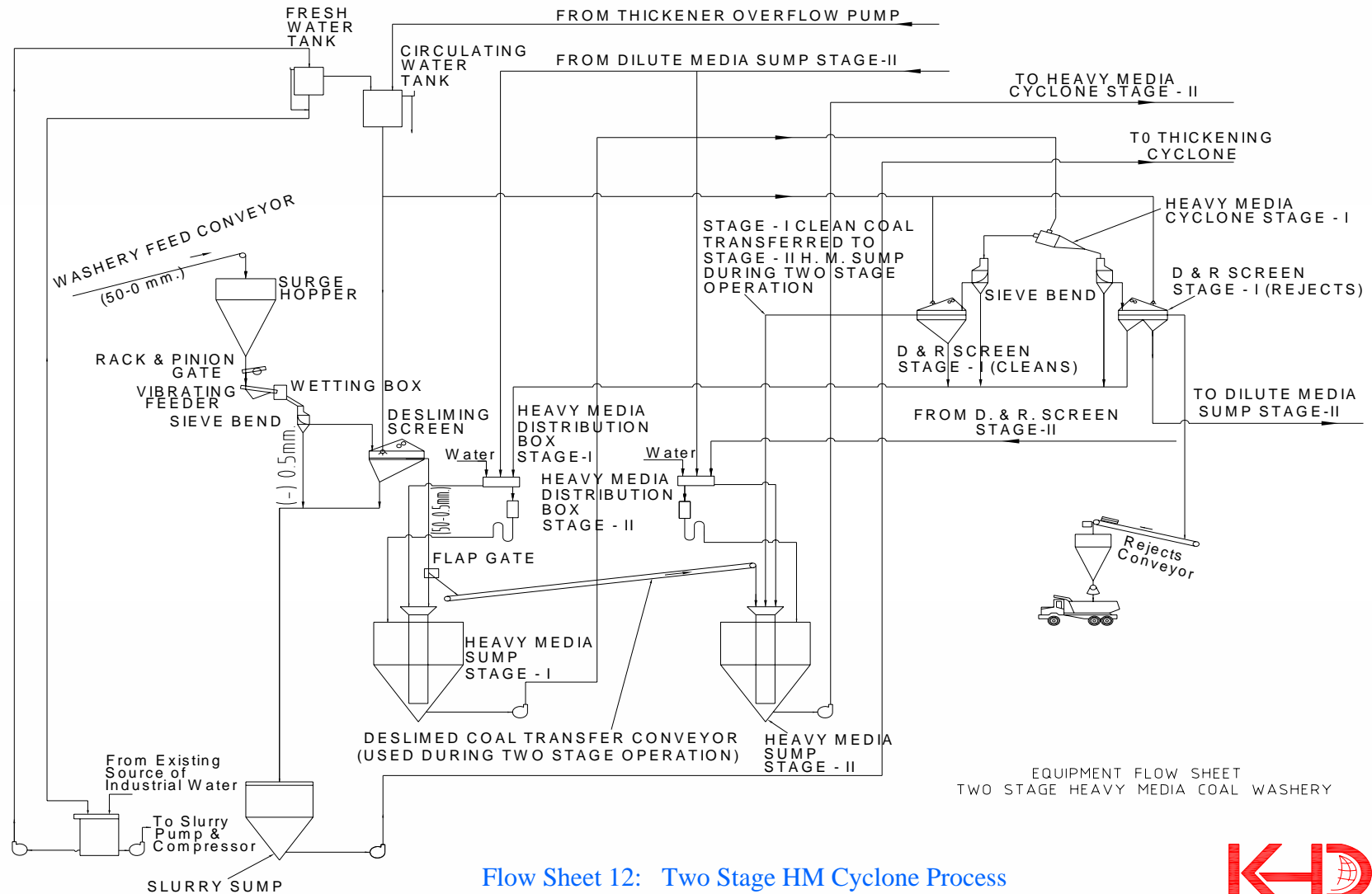


SINGLE / DOUBLE STAGE JIG CUM CYCLONE WASHERY



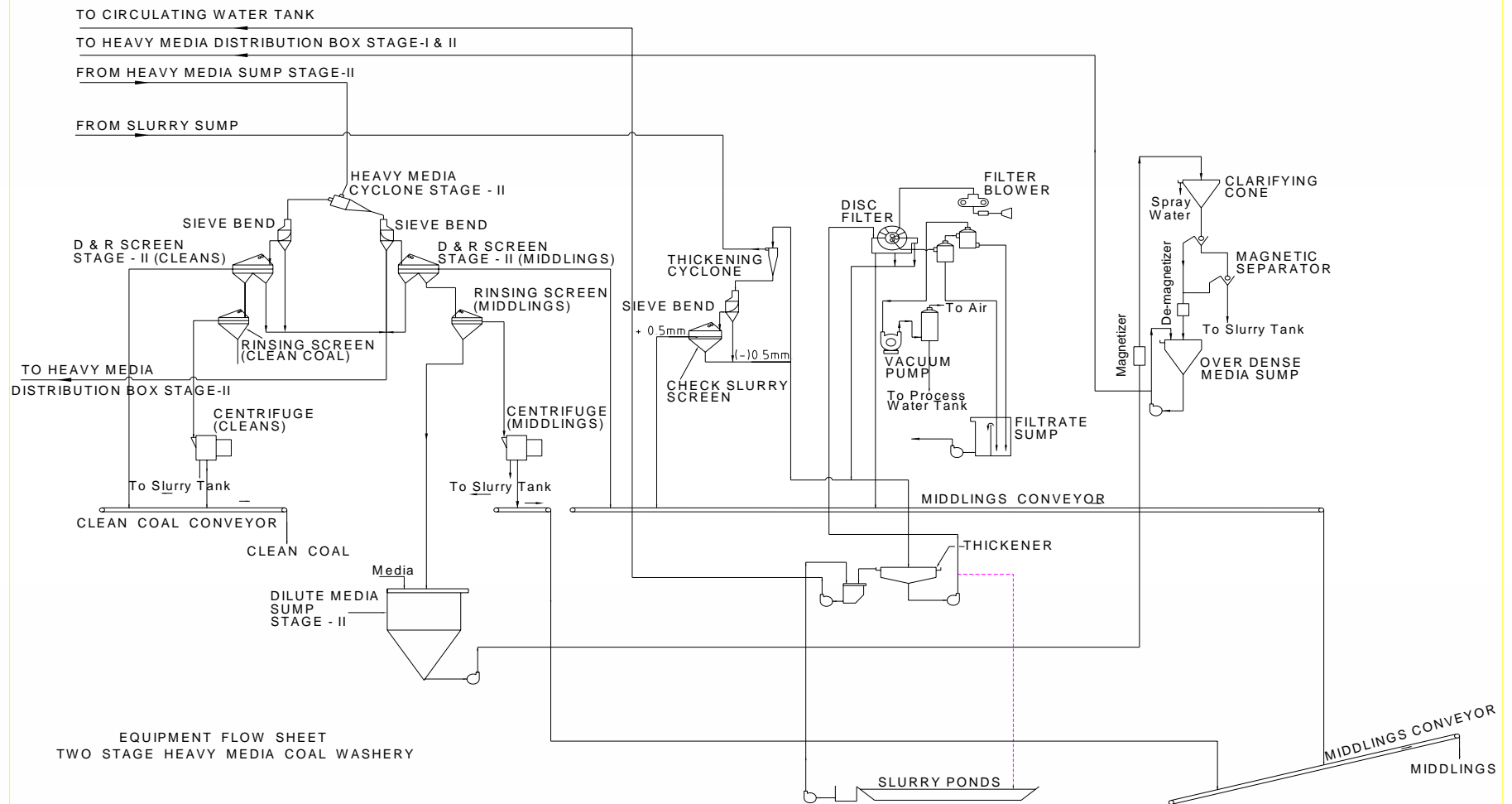
Flow Sheet 11: Slurry Circuit





Flow Sheet 12: Two Stage HM Cyclone Process





Flow Sheet 13: Two Stage HM Cyclone Process

Selection of Process

Selection between the HM & jigging process depends on several factors inter-alia the following:

- raw coal characteristics
- washed coal quality required
- use of reject coal
- operating & maintenance cost
- availability of required quality & quantity of magnetite

Both HM & jigging are the proven processes accepted on worldwide basis for such applications.

Conclusions

According to today's standard it is no longer required or necessary to work with open washery circuits and to damage the environment as well as to spoil energy. The described processes for the various applications have proven their flexibility as well as their acceptance in the coal beneficiation industry. In future it will be a must throughout the world, to beneficiate the raw coal before being used to produce power, cement, sponge iron etc. The users will appreciate the better and consistent coal quality, being fed to their plants.

THANK YOU !

WE VALUE YOUR COMMENTS