

## **SYSTEM DEVICE PROCESS FOR CLASSIFICATION**

### **OF VARIOUS MATERIALS**

#### **5 FIELD OF THE INVENTION**

The present invention relates to production of classified and graded products by segregating various materials such as sand, minerals and the like that contains certain quantity of deleterious material, through an integrated continuous or batch process with  
10 high efficiency in order to improve the end product of the customer and lower its cost of production for users in material & minerals industry. More particularly, the invention relates to a system, a process and a device for classification of various materials.

The advantage of invention is that it provides a unique process for rejection of deleterious material from the feed and production of graded high quality products at  
15 high efficiencies while re-circulating most of the process water within the circuit for reuse. This reduces the requirement of fresh water drastically.

The system, the process and the device of the present invention can be extensively used for processing of, but not limited to, Manufactured sand, Crusher dust, River sand, Glass grade sand & foundry sand etc and minerals like iron ore, bauxite, manganese,  
20 coal, lignite, chromite etc.

#### **BACKGROUND OF THE INVENTION**

Present Solid classification system:

Presently for wet classification equipment such as Wet screens, Bucket wheel recovery systems are used while for some applications Spiral classifiers, Hydrocyclones are  
25 employed. For wet classification recovery of the water is an important aspect. Presently for recovery of water equipment elaborate systems such as traditional Thickeners, Settling ponds/dykes, Water tanks etc are being used.

Disadvantage of the present technology:

Presently classification employs the above mentioned equipment is isolation and does  
30 not present an integrated solution to the user. For example a Wet Screen, Bucket wheel

or a Spiral classifier cuts material at a very coarse size and the rejects contains a large amount of usable material. This material then must be processed by using other systems. Also there is no solution for reuse of the process water and the user must install the traditional water recovery systems separately in order to reuse the process water or face a huge wastage of an important natural resource.

Hydrocyclones are being used for efficient size separation in different industries successfully over the years but again Hydrocyclones alone does not provide a complete solution to the user. The Hydrocyclones discharges the material in a slurry form and therefore the user must create separate facility for dewatering the Hydrocyclones underflow in order to recover good material. Secondly the Hydrocyclones require huge quantity of water in order to function correctly and discharges a high amount of water along with rejects. Here also there is no solution for reuse of the process water and the user must install the traditional water recovery systems separately in order to reuse the process water or face a huge wastage of an important natural resource.

The present invention is the first technology that integrates the facility of both efficient classification of material and the complete waste management & recycling system in a single integrated compact design which allows extraction of graded products from different raw materials with maximum recovery of process water for reuse. One of the examples of the uses of the invention is production of sized and enriched high quality sands that is used on every day basis by the construction industry. This invention will considerably improve the end product quality such as concrete work, plastering etc. Another example is adding value and enhancing the productivity of industries such as iron & steel making plants where efficient removal of silica and alumina present in the ore as the deleterious material can result into lowering of cost of production significantly.

## **OBJECT OF INVENTION**

A basic object of the present invention is to overcome the disadvantages/drawbacks of the known art.

The principal object of invention is to provide a system, a process and a device for an integrated material classification solution to the material & mineral industry while

reducing overall plant footprints, lowering the requirement of water and thus lowering the cost of production.

These and other advantages of the present invention will become readily apparent from the following detailed description read in conjunction with the accompanying drawings.

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## **SUMMARY OF THE INVENTION**

According to one aspect of the present invention, there is provided a method for classification of various materials and/or mineral with variable sizes comprising the steps of

- 10            i.    feeding the material and/or mineral to by the integrated Feeding system (00)
- ii.    discharging the material from the feeding system to the Feed boot (01) for  
                      onward processing
- iii.    adding suitable amount of water on the Split Rinsing Screen (02) through  
                      Booster Pump (13) for washing out the coarse particles ;
- 15            iv.    dewatering the coarse particles obtained in step ii on the Split Rinsing  
                      Screen (02) and provided it to the integrated Product Conveyor 1 (06) for  
                      stock piling;
- v.    discharging the recovered water from Split Rinsing Screen along with fine  
                      particles obtained in step iii to Sump (03) in slurry form;
- 20            vi.    pumping the slurry to hydro-cyclone (04) obtained in step iv with specified  
                      pressure through slurry pump (05);
- vii.    obtaining the mixture from sump and slurry pump and simultaneously  
                      eliminating the wastes
- viii.    recovering the fine particles;
- 25            ix.    discharging the fine particles obtained in step vii by hydro-cyclone(s) in a  
                      slurry form;

- x. dewatering and discharging the fine particles to Product Conveyor 2 (07) for stockpiling;
- xi. recirculating the recovered water and fine particles obtained from Split Rinsing Screen;
- 5 xii. feeding the waste slurry from Hydro-cyclone(s) through wear resistant pipe to pre-fabricated Blending Chamber (08) being located at the side of the Main Slurry Tank (09) of the water reclamation system;
- xiii. cleaning, discharging the clean water from Peripheral Clean Water Tank (11) and recirculating it to the Split Rinsing Screen and Sump through  
10 Booster Pump;
- xiv. discharging the deposited sludge at the bottom of Main Slurry Tank with Scrapping Mechanism (12);
- xv. discharging further the sludge obtained in step xiii by Evacuation Pump (14) and pneumatically operated valves, actuated by Air Compressor (15), to the  
15 desired sludge disposal area; and
- xvi. obtaining the extracted fine graded products with maximum recovery of process water for reuse.

According to another aspect of the present invention, there is provided a system for classification of various materials and/or mineral of variable sizes and extraction of fine  
20 graded particles with waste management and recycling system with maximum recovery of process comprising

- a. an integrated feeding system for processing the materials and/or mineral; said system consisting of a feed hopper, feeder and a belt conveyor wherein said feeding system is adapted to transport the material to the Feed boot and  
25 Split Rinsing Screen;
- b. a dewatering and discharging system comprising Split Rinsing Screen (02); hydrocyclone device (04) integrated Product Conveyor 1 (06); and Sump (03) for obtaining the dewatered and discharged particles in slurry form;

- c. a sizing system comprising hydrocyclone device (04) provided with specified pressure through slurry pump (05) for eliminating the remaining particles and removing the ultra fine particles; and
- d. a waste management system comprising of Blending Chamber (08) being located at the side of the Main Slurry Tank (09) with Scrapping Mechanism (12) and Peripheral Clean Water Tank (11) for obtaining the clean water to recirculate to the process and discharging the sludge to the desired sludge disposal area.

## 10    **BREIF DESCRIPTION OF THE ACCOMPANYING DRAWING**

The above and other aspects, features, and advantages of certain exemplary embodiments of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings in which:

15    Fig. 1 shows the process flow of the present invention for classification of various materials.

Persons skilled in the art will appreciate that elements in the figures are illustrated for simplicity and clarity and may have not been drawn to scale. For example, the dimensions of some of the elements in the figure may be exaggerated relative to other elements to help to improve understanding of various exemplary embodiments of the present disclosure. Throughout the drawings, it should be noted that like reference  
20    numbers are used to depict the same or similar elements, features, and structures.

## **IMPORTANT FEATURES OF THE PRESENT INVENTION**

Some of the salient advantages of the invention are stated below:

- 25    1. Requires phenomenally less space for installation compared to traditional systems of the same capacity that need very large area. The compact nature of the system will allow it to be conveniently used in urban areas, factories, waste management

sites, mobile applications, hilly areas etc. It can be also easily attached with upstream processes.

2. Phenomenal reduction in power consumption again due to compact layout of the system requiring lesser movement of material.

5 3. Can be completely built and assembled in the factory thus significantly lowering installation time and eliminating the risks associated with site fabrication. Besides longer installation time, the high cost and risk of site fabrication are commonly associated with traditional system.

10 4. Modular design that can be dismantled easily and shipped worldwide in containers. Most traditional equipment cannot be shipped efficiently. Also modularity helps when the user desires to relocate the plant to a different project site. Again this is not possible with traditional system.

15 5. Due to standardisation of drawings, it requires considerably less time to manufacture the invention. The conventional system are designed as per the requirements of the site and are hence non-standard which results in longer lead time for manufacture.

20 6. Low level civil foundation requirements due to its integrated steel chassis that allows better weight distribution of the components installed on the system. Traditional systems are installed on large civil pedestals that involve high cost and construction time.

7. The system is complete with all electrical cabling and PLC logic control panel requiring no site electrical work. This is a huge advantage when compared to traditional systems which must be electrically connected at the project site.

## 25 **DETAILED DESCRIPTION OF THE INVENTION**

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as

defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary.

Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing  
5 from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the invention. Accordingly, it should be apparent to those  
10 skilled in the art that the following description of exemplary embodiments of the present invention are provided for illustration purpose only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

It is to be understood that the singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise.

15 By the term “substantially” it is meant that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to those of skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide.

20 Features that are described and/or illustrated with respect to one embodiment may be used in the same way or in a similar way in one or more other embodiments and/or in combination with or instead of the features of the other embodiments.

It should be emphasized that the term “comprises/comprising” when used in this  
25 specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

In accordance with the present invention a single integrated compact system for extraction of fine graded particles is provided that is capable of both efficient

classification of material and the complete waste management and recycling system with maximum recovery of process water for reuse.

In an embodiment a system for classification of various materials and/or mineral with variable sizes and extraction of fine graded particles with waste management and recycling system with maximum recovery of process is provided.

The said system comprises

- a. an integrated feeding system for processing the materials and/or mineral; said system consisting of a feed hopper, feeder and a belt conveyor wherein said feeding system is adapted to transport the material to the Feed boot (01) and Split Rinsing Screen (02);
- b. a dewatering and discharging system comprising Split Rinsing Screen (02); hydrocyclone device (04) integrated Product Conveyor 1 (06); and Sump (03) for obtaining the dewatered and discharged particles in slurry form;
- c. a sizing system comprising hydrocyclone device (04) provided with specified pressure through slurry pump (05) for eliminating the remaining particles and removing the ultra fine particles; and
- d. a waste management system comprising of Blending Chamber (08) being located at the side of the Main Slurry Tank (09) with Scrapping Mechanism (12) and Peripheral Clean Water Tank (11) for obtaining the clean water to recirculate to the process and discharging the sludge to the desired sludge disposal area.

“Process water for reuse” as used herein means the water used by the device during classification process is substantially recovered back from the waste slurry generated by the system. The recovered water is then re-used by the system for further classification operation thus reducing the requirement of fresh water.

Presence of very fine particles and clay in high percentage adversely influence the workability, water demand and element demand. In natural sand presence of very fine particles (lower than 75 microns) are not permitted. Usually at this size range, the particles are in form of mud and clay, which is detrimental for concrete production, and

must be removed. Also in case of artificial/manufactured sand, while producing such manufactured sand particles, the generation of smaller than 75 microns is extremely high, which needs to be removed. It has been proved that if the very fine particles are restricted to 6% it would result in reduced water demand, cement demand and at the same time improve workability. The invention can produce accurately sized and enriched high quality sand by efficiently reducing the quantity of undesired very fine material while at the same time ensuring that none of the usable sand is lost as waste.

This present device has the ability to classify a wide range of the sizes from 0.045micron to 10mm. For example for sand application the device will classify at 0.075mm to 2.36mm, 0,075mm to 5mm or 0.045 to 10mm, as per the requirement of the user.

In an embodiment process for classification of various materials and/or mineral with variable sizes is provided. The process is described herein below:

The material and/or mineral to be processed are fed to the integrated feeding system (marked 00) consisting of feed hopper, feeder and belt conveyor with the help of material handling equipment like Loader/Trucks. The feeding system transports the material to the Feed boot (marked 01) for onward discharge to one part of the Split Rinsing Screen (marked 02) in dry condition. Suitable water quantity is then added on the Split Rinsing Screen through Booster Pump (marked 13) for washing out the coarse particles. The classified coarse particles is then dewatered on the Split Rinsing Screen and delivered to the integrated Product Conveyor 1 (marked 06) for stock piling.

The recovered water from the Split Rinsing Screen along with fine particles is then discharged to the underlying Sump (marked 03) in slurry form.

The slurry is pumped to a set of Hydro-cyclone(s) (marked 04) with specified pressure through Slurry Pump (marked 05) and special type of pipeline. The Hydro-cyclone(s) receives the mixture from Sump, Slurry Pump and eliminates the rejects by removing ultra-fine particles as tailings. The sized particles are simultaneously recovered as a product to the maximum extent.

Then the sized and fine useful particles along with water is discharged by the Hydro-cyclone(s) in a slurry form and fed to the other portion of the Split Rinsing Screen for

dewatering process. The Split Rinsing Screen dewateres and discharges clean useful fine particles to an attached Product Conveyor 2 (marked 07) for stockpiling. The recovered water from the Split Rinsing Screen along with some ultrafine fine particles is discharged to the Sump for recirculation. The ultra-fines form a circulating load within the circuit.

The waste slurry from the Hydro-cyclone(s) is fed through wear resistant pipe work to pre-fabricated Blending Chamber (marked 08) located at the side of the Main Slurry Tank (marked 09) of the water reclamation system. This is also the point where polyelectrolyte is dosed to the slurry via a Flocculants Dosing Tank (marked 10). The dosed sludge travels under a fabricated baffle promoting laminar flow in the transfer pipe to the centre of the Main Slurry Tank. The flow of material further slows and promotes laminar flow into the Main Slurry Tank for downward settlement of sludge.

Then the clean water overflows from the fabricated peripheral channel to the outside of the Main Slurry Tank and discharge into the Peripheral Clean Water Tank (marked 11) which is fused within the water reclamation system. The clean water from the Peripheral Clean Water Tank is then circulated to the Split Rinsing Screen and Sump through Booster Pump for recirculation to the system for classification operation.

The deposited sludge at the bottom of Main Slurry Tank is conditioned to the required consistency and discharged from the same with the help of the Scrapping Mechanism (marked 12) moving the sludge towards the discharge point.

The sludge is then discharge by the factory fitted and directionally tested Evacuation Pump (marked 14) and pneumatically operated valves, actuated by Air Compressor (marked 15), to the desired sludge disposal area.

A programmable logic controlled motor Control Panel (marked 16) governs the entire process system as per desired parameters.

The invention is fully pre-assembled, electrically wired with extensive test carried out prior to dispatch from factory ensuring minimal intervention required by installation and commissioning engineers.

**WE CLAIM:**

1. A method for classification of various materials and/or mineral with variable sizes comprising the steps of

- 5                   i.       feeding the material and/or mineral to by the integrated Feeding system (00);
- ii.       discharging the material from the feeding system to the Feed boot (01) for onward processing;
- iii.       adding suitable amount of water on the Split Rinsing Screen (02) through Booster Pump (13) for washing out the coarse particles;
- 10               iv.       dewatering the coarse particles obtained in step iii on the Split Rinsing Screen (02) and provided it to the integrated Product Conveyor 1 (06) for stock piling;
- v.       discharging the recovered water from Split Rinsing Screen along with fine particles obtained in step iv to Sump (03) in slurry form;
- 15               vi.       pumping the slurry to hydro-cyclone (04) obtained in step v with specified pressure through slurry pump (05);
- vii.       obtaining the mixture from sump and slurry pump and simultaneously eliminating the wastes;
- 20               viii.      recovering the fine particles;
- ix.       discharging the fine particles obtained in step vii by hydro-cyclone(s) in a slurry form;
- x.       dewatering and discharging the fine particles to Product Conveyor 2 (07) for stockpiling;

- xi. recirculating the recovered water and fine particles obtained from Split Rinsing Screen;
  - xii. feeding the waste slurry from Hydro-cyclone(s) through wear resistant pipe to pre-fabricated Blending Chamber (08) being located at the side of the Main Slurry Tank (09) of the water reclamation system;
  - xiii. cleaning, discharging the clean water from Peripheral Clean Water Tank (11) and recirculating it to the Split Rinsing Screen and Sump through Booster Pump;
  - xiv. discharging the deposited sludge at the bottom of Main Slurry Tank with Scrapping Mechanism (12);
  - xv. discharging further the sludge obtained in step xiii by Evacuation Pump (14) and pneumatically operated valves, actuated by Air Compressor (15), to the desired sludge disposal area; and
  - xvi. obtaining the extracted fine graded products with maximum recovery of process water for reuse.
2. The method as claimed in claim 1, wherein said fine particles can be selected from sand and minerals.
  3. The method as claimed in claim 2, wherein said sand particles are selected from crusher dust, river sand, glass grade sand and foundry sand.
  4. The method as claimed in claim 2, wherein said minerals are selected from iron ore, bauxite, manganese, coal, lignite and chromite.
  5. The method as claimed in claim 1, wherein said fine particles is having particle size ranging from 0.045micron to 10mm.

6. A system for classification of various materials and/or mineral of variable sizes and extraction of fine graded particles with waste management and recycling system with maximum recovery of process comprising
- a. an integrated feeding system for processing the materials and/or mineral; said system consisting of a feed hopper, feeder and a belt conveyor wherein said feeding system is adapted to transport the material to the Feed boot (01) and Split Rinsing Screen (02);
  - b. a dewatering and discharging system comprising Split Rinsing Screen (02); hydrocyclone device (04) integrated Product Conveyor 1 (06); and Sump (03) for obtaining the dewatered and discharged particles in slurry form;
  - c. a sizing system comprising hydrocyclone device (04) provided with specified pressure through slurry pump (05) for eliminating the remaining particles and removing the ultra fine particles; and
  - d. a waste management system comprising of Blending Chamber (08) being located at the side of the Main Slurry Tank (09) with Scrapping Mechanism (12) and Peripheral Clean Water Tank (11) for obtaining the clean water to recirculate to the process and discharging the sludge to the desired sludge disposal area.
7. The system as claimed in claim 6, wherein said size of the particles ranges from 0.045micron to 10mm.
8. The system as claimed in claim 6, wherein said system further comprises pre-fabricated Blending Chamber (08) being located at the side of the Main Slurry Tank (09) of the water reclamation system.
9. The system as claimed in claim 6, wherein said system further comprises a Booster pump (13) adapted for recirculation of clean water obtained from Peripheral Clean Water Tank (11).

10. The system as claimed in claim 6, wherein said system further comprises a Scraping mechanism (12) adapted to provide the discharged sludge.

11. The system as claimed in claim 6, wherein said system further comprises Evacuation Pump (14) and pneumatically operated valves, actuated by Air Compressor (15) for obtaining the discharged sludge.

12. The system as claimed in claim 6, wherein said system further comprises a programmable logic controlled motor Control Panel (16) adapted to monitor the system.