SYSTEMS AND METHOD FOR WASHING AND GRADING PARTICULATE MATERIAL

TECHNICAL FIELD

The present subject matter described herein, in general, relates to washing and grading of particulate material, in particular silica sand for applications in foundry, glass and construction, by segregating range of desired particle size from bulk material such as crushed sand stone, sand from quarries, sand from rivers and/or minerals. More particularly, the invention relates to a method and system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water with high efficiency, in order to improve the end product and lower the cost of production in downstream industry.

BACKGROUND

Presently for wet classification of particles, equipment's such as wet screens and bucket wheel recovery systems are used, while for some applications spiral classifiers and hydrocyclones are employed. For wet classification, recovery of water is an important aspect. Presently, for recovery of water, elaborate systems such as traditional thickeners, settling ponds/dykes and water tanks are being used.

Current classification methods employ the above-mentioned equipment's in isolation and do not present an integrated solution to users. For example, a wet screen, bucket wheel or a spiral classifier separates material at a very coarse size and the rejects contain a large amount of usable material. This material then must be processed by using other systems. Also, there is no solution for reusing the process water and the user must install traditional water recovery systems separately, in order to reuse the process water and preventing 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 do not provide a complete solution to the users. A hydrocyclone discharges material in a slurry form and therefore the user must create separate facility for dewatering underflow of the hydrocyclone in order to recover good material. Secondly, the hydrocyclones discharge a high amount of water along with rejects and require huge quantity of water in order to function correctly. Here also there isn't any solution for reusing the process water.

Thus, there exists a need for a system and method that overcomes the limitation and drawbacks of the known art. The present invention is uniquely integrating the facility of both efficient sizing & classification of material and complete waste management and water recycling system in a single integrated compact design. The present invention allows extraction of graded products from different raw materials with maximum recovery of the process water for reuse.

SUMMARY OF THE INVENTION

The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the present invention. It is not intended to identify the key/critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concept of the invention in a simplified form as a prelude to a more detailed description of the invention presented later.

An objective of the present invention is to provide a method, system and a device for an integrated sand washing and classification solution to the foundry and glass making industry while reducing overall plant footprints, lowering the requirement of water through integrated water management system, lowering power requirement and thus lowering the cost of production.

According to one aspect, the present invention provides a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste

management and water recycling system with maximum recovery of process water. The system comprises of a degritting screen adapted to receive a particulate material from a feeding system, wherein a feed slurry with water is collected from the degritting screen; a conveyor adapted to receive trash oversize from the degritting screen for dumping; a fine screen adapted to receive the feed slurry and screen out fine particles; a conveyor adapted to receive dewatered coarse particles for the fine screen overflow and stockpiling the same as a coarse product; a first hydrocyclone adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject; a dewatering screen adapted to receive the hydrocyclone underflow with desired range of particles and generate dewatered particles on a conveyor where the dewatered particles are stockpiled as final product; and a water recycling system adapted to receive hydrocyclone overflow for recovering and collecting water in a clean tank and recirculating the water in the system using pump.

In another aspect, the present invention provides a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water. The system comprises of a degritting screen adapted to receive a particulate material from a feeding system, wherein a feed slurry with water is collected from the degritting screen; a conveyor adapted to receive trash oversize from the degritting screen for dumping; a fine screen adapted to receive the feed slurry and screen out fine particles; a conveyor adapted to receive dewatered coarse particles for the fine screen overflow and stockpiling the same as a coarse product; a first hydrocyclone adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject; a second hydrocyclone adapted to receive the first hydrocyclone underflow with desired range of particles so as to further eliminate remaining ultrafine particles; a dewatering screen adapted to receive the second hydrocyclone underflow with desired range of particles and generate dewatered particles on a conveyor where the dewatered particles are stockpiled as final product; and a water recycling system adapted to receive first hydrocyclone overflow and second hydrocyclone overflow for recovering and collecting water in a clean tank and recirculating the water in the system using with pump.

In another aspect, the present invention provides a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water. The system comprises of a degritting screen adapted to receive a particulate material from a feeding system, wherein a feed slurry with water is collected from the degritting screen; a conveyor adapted to receive trash oversize from the degritting screen for dumping; a fine screen adapted to receive the feed slurry and screen out fine particles; a conveyor adapted to receive dewatered coarse particles for the fine screen overflow and stockpiling the same as a coarse product; a first hydrocyclone adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject; a hydraulic classifier with counter current water from bottom adapted to receive the first hydrocyclone underflow with desired range of particles and remove preselected coarse fraction from the first hydrocyclone underflow, wherein oversize particles from the first hydrocyclone underflow report to the overflow of the counter current hydraulic classifier with most of the water; a dewatering screen adapted to receive the hydraulic classifier underflow with desired range of particles and generate dewatered particles on a conveyor where the dewatered particles are stockpiled as final product; and a water recycling system adapted to receive the first hydrocyclone overflow and the hydraulic classifier overflow for recovering and collecting water in a clean tank and recirculating the water in the system using with pump.

In another aspect, the present invention provides system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water. The system comprises of a split screen adapted to receive a particulate material from a feeding system , wherein a feed slurry with water is collected from the screen; a conveyor adapted to receive trash oversize from the degritting screen for dumping; a first hydrocyclone adapted to receive fine particles in the feed slurry for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject and feeding the first hydrocyclone underflow to dewatering side of the split screen; an attrition scrubber adapted to receive dewatered feed particles from the split screen, wherein the attrition scrubber facilitates intense surface attrition for dislodging adhering particles of heavy minerals; a

sump with water for necessary dilution of the scrubbed particles; a second hydrocyclone adapted to receive fine particles filtered by a fine screen and remove preselected ultrafine particles with most of the water to the hydrocyclone overflow as reject; a set of spiral concentrator adapted to receive second hydrocyclone underflow and separate the dislodged heavy mineral particles; a third hydrocyclone adapted to receive and dewater material from the spiral separator; a dewatering screen adapted to receive the first, second and the third hydrocyclone underflow with desired range of particles and generate dewatered particles on a conveyor where the dewatered particles are stockpiled as final product; and a water recycling system adapted to receive the first, second and the third hydrocyclone overflow for recovering and collecting water in a clean tank and recirculating the water in the system using with pump .

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

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:

Figure 1 illustrates a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, according to one embodiment of the present invention.

Figure 2 shows a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, according to second embodiment of the present invention.

Figure 3 illustrates a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling

system with maximum recovery of process water, according to third embodiment of the present invention.

Figure 4 illustrates a system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, according to fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

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

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.

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 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.

According to one embodiment of the present invention as shown in Figure 1, a system is provided for classification of various sand of variable sizes and extraction of fine graded particles with waste management and water recycling system and with maximum recovery of process water comprising an integrated feeding system (100) having a feed hopper, feeder and a belt conveyor, wherein said feeding system is adapted to transport particulate material to a degritting screen (101). Suitable amount of water is added on the degritting screen (101) through a recirculating water pump (118) for washing out the feed particles to screen underflow, rejecting trash on the screen to a conveyor (102) and dumping the same as a reject. Tramp oversize from the degritting screen (101) is discharged to a conveyor (102) for dumping and water recovered from the degritting screen (101) along with feed particles obtained in the previous step is discharged to a sump (103) in slurry form and the slurry from the sump (103) is pumped by a slurry pump (104) to a fine screen (105) for screening out the desired size of fine particles to the screen underflow. The selected fine particles are then recovered to a sump (107), and the dewatered coarse particles are collected from the fine screen overflow as a coarse product and stockpiled by a conveyor (106). Thereafter, the fine particles with most of the water obtained after dewatering the coarse particles are collected to sump (107) and the slurry in sump (107) is pumped to another sump (109) by slurry pump (108), and slurry from sump (109) is pumped to a hydrocyclone (111) by a pump (110) attached to sump (109) at requisite pressure so as

to remove the preselected ultrafine particles with most of the water to hydrocyclone overflow as reject. Thereafter, the hydrocyclone (111) underflow is directed with desired range of particles to a dewatering screen (112), the dewatered particles are collected in a conveyor (113) for stockpiling as the final product. Further, the recovered water and fine particles obtained from dewatering screen (112) is recirculated to a sump (109) for recirculation and the waste slurry from hydrocyclone overflow is fed, through a wear resistant pipe, to a water recycling system (116) after deaerating and mixing with flocculants (115) in a pre-fabricated chamber (114) being located at the side of the water recycling system (116). The clean water is discharged from peripheral launder of the water recycling system (116) to a clear water tank (117) and pumped to various points in the circuit such as degritting screen (101), fine screen (105) and various sumps through a recirculating water pump (118). Following which, the deposited sludge at the bottom of water recycling system is discharged with scrapping mechanism and the sludge obtained at the bottom of water recycling system (116) is further discharged by a slurry evacuation pump (119) with pneumatically operated valves, (actuated by air compressor) to the designated sludge disposal area (pond) after mixing with special flocculants (121) in a mixing tube (120) which allows further water recovery and quicker settlement of the sludge. Thus, the extracted fine graded products are obtained with maximum recovery of process water for reuse. This whole operation is controlled by a PLC system (122).

According to second embodiment of the present invention as shown in Figure 2, there is provided a system for classification of various sands of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water comprising an integrated feeding system (200) having a feed hopper, feeder and a belt conveyor, wherein said feeding system is adapted to transport material to a degritting screen (201). Suitable amount of water is added on the degritting screen (201) through a recirculating water pump (219) for washing out the feed particles to screen underflow. Firstly, tramp oversize from degritting screen (201) is discharged to a conveyor (202) for dumping and the recovered feed particles with water are collected in a sump (203) in slurry form. Subsequently, the feed slurry is pumped to a fine screen (205) by a pump (204) for screening out the desired size of fine particles to the screen underflow and the selected fine particles are recovered to sump (207). The dewatered coarse particles

are collected from fine screen (205) overflow as a coarse product and stockpiled by conveyor (206). Thereafter, the slurry in the sump (207) is pumped to a hydrocyclone (209) by a pump (208) at requisite pressure and the preselected ultrafine fraction of feed report to the hydrocyclone overflow and is removed with most of the water. Thereafter, the hydrocyclone underflow is directed with desired range of particles to another sump (210) with a pump (211) and fed to a second stage of hydrocyclone (212) after adding water so as to further eliminate remaining ultrafine to hydrocyclone (212) overflow with most of the water. The second stage hydrocyclone underflow is then directed with desired range of particles to a dewatering screen (213) from which the dewatered particle are collected in a conveyor (214) and stockpiled as the final product. Further, the recovered water and the some very fine particles obtained from the dewatering screen (213) are recirculated to the sump (210) and the waste slurry from both the hydrocyclone overflow is fed through a wear resistant pipe to a water recycling system (217) after deaerating and mixing with flocculants (216) in a pre-fabricated chamber (215) being located at the side of the water recovery system. The recovered water is collected in a clear water tank (218) and pumped to various points in the circuit by pump (219). Lastly, the deposited sludge at the bottom of water recycling system (217) is discharged with scrapping mechanism and the sludge obtained is further discharged by a slurry evacuation pump (220) with pneumatically operated valves, (actuated by air compressor) to the designated sludge disposal area after mixing with special flocculants (222) in a mixing tube (221) which allows further water recovery and quicker settlement of sludge. Thus, obtaining the extracted fine graded products with maximum recovery of process water for reuse. This whole operation is controlled by a PLC system (223).

According to third embodiment of the present invention as shown in Figure 3, there is provided a system for classification of various sands of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water comprising an integrated feeding system (300) having a feed hopper, feeder and a belt conveyor, wherein said feeding system (300) is adapted to transport material to a degritting screen (301). Suitable amount of water is added on the degritting screen (301) through a recirculating water pump (318) for washing out the feed

particles to screen underflow. Firstly, tramp oversize from degritting screen (301) is discharged to a conveyor (302) for dumping and the recovered feed particles with water are collected in a sump (303) in slurry form. Subsequently, the feed slurry is pumped to a fine screen (305) by a pump (304) for screening out the desired size of fine particles to the screen underflow and recovering to a sump (307). The dewatered coarse particles are collected from the fine screen overflow and discharged to a conveyor (306) for stockpiling as coarse product. Thereafter, the fine particles from sump (307) are pumped by pump (308) in a slurry form to a hydrocyclone (309) for removing the preselected ultrafine particles with most of the water to hydrocyclone overflow as reject. Thereafter, the hydrocyclone underflow is directed with desired range of particles to a hydraulic classifier (310) with counter current water from bottom for removing some preselected coarse fraction. The oversize particles from the hydrocyclone (309) underflow report to the feed of the counter current hydraulic classifier (310) with most of the water. The hydraulic classifier underflow is then directed with desired range of particles to a sump (311) and pumped to hydrocyclone (313) by pump (312) for removing most of water to the overflow and the coarse underflow reports to dewatering screen (314),from which the dewatered particles are collected in a conveyor (315) and stockpiled as the final product. The recovered water and fine particles obtained from the dewatering Screen (314) is recirculated to a sump (311). Further, the waste overflow slurry from both the hydrocyclones and the hydraulic classifier is fed through a wear resistant pipe to a water recycling system (317) after deaerating and mixing with flocculants (324) in a pre-fabricated chamber (316) being located at the side of the water recycling system. The clean water from peripheral launder of the water recycling system is discharged to a clean water tank (318) and recirculated to the degritting screen (301), fine screen (305) and various sumps through recirculating water pump (319). The deposited sludge at the bottom of the water recycling system is discharging with scrapping mechanism and the obtained sludge is further discharged by a slurry evacuation pump (320) with pneumatically operated valves, (actuated by air compressor) to the designated sludge disposal area after mixing with special flocculants (322) in a mixing tube (321) which allows further water recovery and quicker settlement of the sludge. Thus, obtaining the extracted fine graded products with maximum recovery of process water for reuse. The whole operation is controlled by a PLC system (323).

According to fourth embodiment of the present invention as shown in Figure 4, there is provided a system for classification of various sands of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water comprising an integrated feeding system (400) having a feed hopper, feeder and a belt conveyor, wherein said feeding system is adapted to transport the material to the degritting side of a split screen (401). Suitable amount of water is added on the screen through a recirculating water pump (426) for washing out the feed particles to screen underflow, rejecting trash on the screen to a conveyor (402) and dumping the same as a reject. The feed particles with water report to a sump (403) in slurry form and is pumped to a first stage of hydrocyclone (405) using pump (404) at requisite pressure so as to remove preselected size of ultrafine particles to the hydrocyclone overflow with most of the water. Subsequently, hydrocyclone underflow (coarse particles) is directed to dewatering part of the split screen (401), after which the dewatered feed particles with measured water are discharged to an attrition scrubber (406) for intense surface attrition for dislodging adhering particles of heavy minerals particularly iron, titanium and alumina minerals. Thereafter, the scrubbed particles are discharged to a sump (407) with water for necessary dilution and the feed slurry is pumped to a fine screen (409) by a pump (408) for separation of the selected fine particles to the screen underflow efficiently and dewatering and discharging the coarse particles to a conveyor (410) for stockpiling as a coarse product suitable for the construction industry. The fine particles from screen underflow with most of the water are discharged to a sump (411) in slurry form and then pumped to a hydrocyclone (413) by pump (412) at requisite pressure for removing most of the water to hydrocyclone overflow with most of the water. The hydrocyclone (413) underflow with desired range of particles is then directed to a set of spiral concentrator (414) separating the dislodged heavy mineral particles having a higher specific gravity than sand as reject. The spiral separator heavies are rejects and are dumped on ground. The washed, beneficiated good quality sand from the spiral concentrator (414) is then collected in a sump (415) along with overflow from hydrocyclone and pumped by pump (416) to another sump (417) from where it is pumped by pump (418) to a third stage of hydrocyclone (419) for dewatering and separating the remaining ultrafine particles to the hydrocyclone overflow. The hydrocyclone (419) underflow is fed to a dewatering screen (420) to dewater the product which is then collected in a conveyor (421) for stockpiling as the final product for the Glass industry and the water

falls back into sump (417). The waste overflow slurry from hydrocyclone stages (405, 419) is fed through a wear resistant pipe to a water recycling system (424) after deaerating and mixing with flocculants (423) in a pre-fabricated chamber (422) being located at the side of the water recycling system. The clean water is discharged from peripheral launder of the water recycling system to a clean water tank (425) and recirculated to the degritting screen (401), fine screen (409) and various sumps through recirculating water pump (426). Further, the deposited sludge at the bottom of the water recycling system is discharged with scrapping mechanism and the obtained sludge is further discharged by a slurry evacuation pump (427) with pneumatically operated valves, (actuated by air compressor) to the designated sludge disposal area after mixing with special flocculants (429) in a mixing tube (428) which allows further water recovery and quicker settlement of the sludge. Thus, obtaining the extracted fine graded products with maximum recovery of process water for reuse. The operation is controlled by a PLC system (430).

The present invention in all the embodiments has the ability to classify a wide range of the particle sizes. In the third embodiment, additional particle sizes could be individually classified as the system allows more close control on the size gradation of the final product. The system also beneficiates the raw material to produce quality product from inferior grade material. A programmable logic-controlled motor control panel (marked 122, 223, 323 and 430) 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.

Thus, the present invention provides a unique system and method for rejection of oversized and undersized fractions from the feed and production of graded high quality products at 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 and method of the present invention can be extensively used for processing of, but not limited to foundry grade sand, glass grade sand of various types, fracking sand, sports and horticultural sand, filter sand, equestrian sands, clay production, construction sand for high performance concrete, etc. One of the examples of the uses of the present invention is production of washed and sized high-quality sands to be used on every day basis by the foundry, glass and construction industry. This invention considerably improves the end product quality such as metallic and non-metallic casting in downstream industries and provides good quality material for production of coloured glass for the bottling industry, high performance concrete, plastering work etc.

Some of the non-limiting advantages of the present invention are mentioned below:

- 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.
- Phenomenal reduction in power consumption again due to compact layout of the system requiring lesser movement of material.
- 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.
- 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.
- Due to standardisation of drawings, it requires considerably less time to manufacture the invention. The conventional system is designed as per the requirements of the site and are hence non-standard which results in longer lead time for manufacture.

- 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.
- 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.
- The system allows more close control on the size gradation of the final product and also beneficiates raw material to produce quality product from inferior grade material.

Although a system and method for washing and grading particulate material have been described in language specific to structural features and/or methods, it is to be understood that the embodiments disclosed in the above section are not necessarily limited to the specific features or methods or devices described. Rather, the specific features are disclosed as examples of implementations of the washing and grading system.

CLAIMS

1. A system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, the system comprising:

   a degritting screen (101) adapted to receive a particulate material from a feeding system (100), wherein feed slurry with water is collected from the degritting screen (101);

   a conveyor (102) adapted to receive trash oversize from the degritting screen (101) for dumping;

   a fine screen (105) adapted to receive the feed slurry and screen out fine particles;

   a conveyor (106) adapted to receive dewatered coarse particles for the fine screen (105) overflow and stockpiling the same as a coarse product;

   a first hydrocyclone (111) adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject;

   a dewatering screen (112) adapted to receive the hydrocyclone underflow with desired range of particles and generate dewatered particles on a conveyor (113) where the dewatered particles are stockpiled as final product; and

   a water recycling system (116) adapted to receive hydrocyclone overflow for recovering and collecting water in a clean tank (117) and recirculating the water in the system using pump (118).

2. The system as claimed in claim 1, wherein the fine screen (105) is capable of fine particle separation in wet condition.

3. The system as claimed in claim 1, wherein the dewatering screen (112) is capable of producing product with 10-15% moisture in the product so that it can be easily conveyed.

4. The system as claimed in claim 1, wherein the system is controlled by a PLC system (122).

5. The system as claimed in claim 1 and 4, wherein said system further comprises a programmable logic-controlled motor control panel adapted to monitor the system.

6. A system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, the system comprising:

a degritting screen (201) adapted to receive a particulate material from a feeding system (200), wherein feed slurry with water is collected from the degritting screen (201);

a conveyor (202) adapted to receive trash oversize from the degritting screen (201) for dumping;

a fine screen (205) adapted to receive the feed slurry and screen out fine particles;

a conveyor (206) adapted to receive dewatered coarse particles for the fine screen (205) overflow and stockpiling the same as a coarse product;

a first hydrocyclone (209) adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone (209) overflow as reject;

a second hydrocyclone (212) adapted to receive the first hydrocyclone (209) underflow with desired range of particles so as to further eliminate remaining ultrafine particles;

a dewatering screen (213) adapted to receive the second hydrocyclone (212) underflow with desired range of particles and generate dewatered particles on a conveyor (214) where the dewatered particles are stockpiled as final product; and

a water recycling system (217) adapted to receive first hydrocyclone (209) overflow and second hydrocyclone (212) overflow for recovering and collecting water in a clean tank (218) and recirculating the water in the system using pump (219).

7. The system as claimed in claim 6, wherein the fine screen (205) is capable of fine particle separation in wet condition.

8. The system as claimed in claim 6, wherein the dewatering screen (213) is capable of producing product with 10-15% moisture in the product so that it can be easily conveyed.

9. The system as claimed in claim 6, wherein the system is controlled by a PLC system (223).

10. The system as claimed in claim 6 and 9, wherein said system further comprises a programmable logic-controlled motor control panel adapted to monitor the system.

11. A system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, the system comprising:

a degritting screen (301) adapted to receive a particulate material from a feeding system (300), wherein feed slurry with water is collected from the degritting screen (301);

a conveyor (302) adapted to receive trash oversize from the degritting screen (301) for dumping;

a fine screen (305) adapted to receive the feed slurry and screen out fine particles;

a conveyor (306) adapted to receive dewatered coarse particles from the fine screen (305) overflow and stockpiling the same as a coarse product;

a first hydrocyclone (309) adapted to receive the fine particles in slurry form for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject;

a hydraulic classifier (310) with counter current water from bottom adapted to receive the first hydrocyclone (309) underflow with desired range of particles and remove preselected coarse fraction from the first hydrocyclone (309) underflow, wherein oversize particles from the first hydrocyclone underflow report to the overflow of the counter current hydraulic classifier (310) with most of the water;

a dewatering screen (314) adapted to receive the hydraulic classifier (310) underflow with desired range of particles and generate dewatered particles on a conveyor (315) where the dewatered particles are stockpiled as final product; and

a water recycling system (317) adapted to receive the first hydrocyclone (309) overflow and the hydraulic classifier (310) overflow for recovering and collecting water in a clean tank (318) and recirculating the water in the system using pump (319).

12. The system as claimed in claim 11, wherein the fine screen (305) capable of fine particle separation in wet condition.

13. The system as claimed in claim 11, wherein the dewatering screen (314) is capable of producing product with 10-15% moisture in the product so that it can be easily conveyed.

14. The system as claimed in claim 11, wherein the system is controlled by a PLC system (323).

15. The system as claimed in claim 11 and 14, wherein said system further comprises a programmable logic-controlled motor control panel adapted to monitor the system.

16. A system for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, the system comprising:

a split screen (401) adapted to receive a particulate material from a feeding system (400), wherein feed slurry with water is collected from the screen (401);

a conveyor (402) adapted to receive trash oversize from the degritting screen for dumping;

a first hydrocyclone (405) adapted to receive fine particles in the feed slurry for removing preselected ultrafine particles with most of water to hydrocyclone overflow as reject and feeding the first hydrocyclone (405) underflow to dewatering side of the split screen (401);

an attrition scrubber (406) adapted to receive dewatered feed particles from the split screen (401), wherein the attrition scrubber (406) facilitates intense surface attrition for dislodging adhering particles of heavy minerals;

a sump (407) with water for necessary dilution of the scrubbed particles;

a second hydrocyclone (413) adapted to receive fine particles filtered by a fine screen (409) and remove preselected ultrafine particles with most of the water to the hydrocyclone (413) overflow as reject;

a set of spiral concentrator (414) adapted to receive second hydrocyclone (413) underflow and separate the dislodged heavy mineral particles;

a third hydrocyclone (419) adapted to receive and dewater material from the spiral separator (414);

a dewatering screen (420) adapted to receive the third hydrocyclone underflow with desired range of particles and generate dewatered particles on a conveyor (421) where the dewatered particles are stockpiled as final product; and

a water recycling system (424) adapted to receive the first, and the third hydrocyclone overflow for recovering and collecting water in a clean tank (425) and recirculating the water in the system using pump (426).

17. The system as claimed in claim 16, wherein the fine screen (409) is capable of fine particle separation in wet condition.

18. The system as claimed in claim 16, wherein the dewatering screen (420) is capable of producing product with 10-15% moisture in the product so that it can be easily conveyed.

19. The system as claimed in claim 16, wherein the system is controlled by a PLC system (430).

20. The system as claimed in claim 16 and 19, wherein said system further comprises a programmable logic-controlled motor control panel adapted to monitor the system.

21. A method for classification of particulate material of variable sizes and extraction of fine graded particles with waste management and water recycling system with maximum recovery of process water, the method comprising steps of:

discharging by a feeding system (100), particulate material to a degritting screen (101);

adding suitable amount of water to the degritting screen (101) for washing out feed particles to the screen underflow;

rejecting trash on the screen to a conveyor (102) and dumping the same as reject;

pumping the water recovered from the degritting screen (101) along with feed particles obtained from the degritting screen (101), in a slurry form to a fine screen (105) for screening out fine particles of desired size;

discharging dewatered coarse particles on the fine screen (105) to a conveyor (106) and stockpiling the same as a coarse product;

collecting the fine particles and pumping the same to first hydrocyclone (111) at requisite pressure;

directing the first hydrocyclone underflow to a dewatering screen (112) and discharging dewatered particles to a conveyor (113) for stockpiling as final product;

recirculating recovered water and fine particles obtained from the dewatering screen (112) to a sump (109); and

feeding waste slurry from the first hydrocyclone (111) overflow to a water recycling system (116) where;

discharging clean water from a peripheral launder of the water recycling system (116) to a clean water tank (117) and recirculating it to the degritting screen (101), fine screen (105) and various sumps.

22. The method as claimed in claim 21, wherein the first hydrocyclone (209) underflow after requisite dilution is directed to a second hydrocyclone (212) for further elimination of preselected ultrafine particles.

23. The method as claimed in claim 21, wherein the overflow from both first and second hydrocyclone (209, 212) is directed to the water recycling system (217).

24. The method as claimed in claim 21, wherein first hydrocyclone (309) underflow is directed to a hydraulic classifier (310) with counter flow water from bottom for further removing predesigned coarser fraction of feed to the classifier overflow with most of the water.

25. The method as claimed in claim 21 and 24, wherein the overflow from both first hydrocyclone (309) and the hydraulic classifier (310) is directed to the water recycling system (317).

26. The method as claimed in claim 21, wherein the method further comprises steps of:

discharging dewatered coarse particles on dewatering side of a split screen (401) to an attrition scrubber (406) for surface attrition;

collecting the obtained scrubbed feed particles in a sump (403) after surface attrition, for necessary dilution of the scrubbed particles;

pumping the slurry from the sump (403) to a fine screen (409) for separation of selected fine particles to screen underflow efficiently;

pumping to a second hydrocyclone (413), fine particles collected from the fine screen underflow with most of water, at requisite pressure for removing ultrafine particles with most of the water to the hydrocyclone (413) overflow as reject;

directing the second hydrocyclone (413) underflow to a spiral concentrator (414) for separating dislodged heavy mineral particles;

directing slurry from the spiral concentrator (414) to a third hydrocyclone (419) with requisite pressure for separating remaining ultrafine particles.

27. The method as claimed in claims 21-26, wherein the waste slurry from the hydrocyclone overflow is fed to the water recycling system (116, 217, 317, 424) through a water resistant pipe after deaerating and mixing with flocculants (115, 216, 324, 423) in a pre-fabricated chamber (114, 215, 316, 422) being located at the side of the water recycling system (116, 217, 317, 424).

28. The method as claimed in claims 21-27, wherein the deposited sludge at the bottom of the water recycling system (116, 217, 317, 424) is discharged with scrapping mechanism.

29. The method as claimed claims 21-28, wherein the sludge is discharged by a slurry evacuation pump (119, 220, 320, 427) with pneumatically operated valves, actuated by air compressor, to designated sludge disposal area after mixing with special flocculants (121, 222, 322, 429) in a mixing tube (120, 221, 321, 428), which allows further water recovery and quicker settlement of the sludge.

30. The method as claimed in claim 21-29, wherein the method is controlled by a PLC system (122, 223, 323, 430).