

WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION EM-01-04

CHEMICAL BAG SPLITTING MACHINE AND ACCESSORIES

Revision Date: 31.8.2022

## **CONTENT**

### **CHEMICAL BAG SPLITTING MACHINE AND ACCESSORIES**

	<b><u>Page</u></b>
1. General Design and Installation Standards	1
2. General Requirements	2
3. Roller Table	2
4. Inclined Belt Conveyor	3
5. Chemical Bag Splitting Machine	3
6. Horizontal Screw Conveyor	5
7. Vertical/Inclined Screw Conveyor	6
8. Bag Compactor	7
9. Chemical Dust Extraction Unit	7
10. Control and Operation Sequences	8
11. Motors for Plant Drives	8
12. Chemical Handling Local Control Panel	9
13. Inspection and Tests	11

## **CHEMICAL BAG SPLITTING MACHINE AND ACCESSORIES**

### **1. GENERAL DESIGN AND INSTALLATION STANDARDS**

#### **1.1 Water Supplies Department Standard Specifications**

The following Standard Specifications shall be complied with:

EM-00-01	Inspection, Testing and Reporting
EM-00-03	General Requirements for Supply of Mechanical, Electrical and Instrumentation Plant and Equipment
EM-90-01	Drawing for Mechanical, Electrical and Instrumentation Plant and Equipment
EM-90-02	Instruction Manual for Mechanical, Electrical and Instrumentation Plant and Equipment
E-00-01	Electrical Equipment - General
E-11-03	Electrical and Instrumentation Panels and Cubicles
E-51-04	Squirrel Cage Induction Motors below 40kW

In case of discrepancy in technical requirements, this Specification shall take precedence of the above WSD Standard Specifications.

#### **1.2 Standards**

The design and installation of the machine shall comply with the latest version of relevant International Electrotechnical Commission (IEC) Standards, British Standards (BS), Codes of Practice or other equivalent standards issued by internationally recognized engineering institutions or organizations.

The following standards, in particular, shall apply where appropriate:

BS EN ISO 14890	Conveyor belts – Specification for rubber- or plastics-covered conveyor belts of textile construction for general use
IEC 60034-5	Rotating electrical machines – Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification
IEC 60529	Degrees of protection provided by enclosures (IP code)
BS 8438	Troughed belt conveyors – Specification
BS 7671	Requirements for electrical installations – the IET Wiring Regulations

IEC 60947-7-1	Low-voltage switchgear and controlgear. Ancillary equipment - Terminals blocks for copper conductors
IEC 60335-2-69	Household and similar electrical appliances – Safety. Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use
BS 2567	Specification for Non-powered roller conveyors

The IEC, BS and other standards referred to in this Specification shall also mean the equivalent standards issued by internationally recognized engineering institutions or organizations. Manufacturers offering equipment complying with other standards shall provide duplicate copies of such standards in English, together with full details of any deviations from the standards referred to in this Specification.

## **2. GENERAL REQUIREMENTS**

This Specification covers the requirements of the chemical bag splitting machine and its associated equipment, including the roller table, inclined belt conveyor, horizontal screw conveyor, vertical/inclined screw conveyor, bag compactor and dust extraction unit.

The splitting machine and accessories shall be of proven design with records of installation showing that they are free of operation and maintenance problems. In particular, the machine shall not be choked by small pieces of bag paper cut out during the splitting process.

In general, chemical bags shall be loaded onto the roller table and shifted one by one to the inclined belt conveyor for automatic transfer to the splitting machine. The splitting machine shall then cut the chemical bags, sieve the bag fabrics, separate and discharge the chemical to a screw conveyor assembly. The screw conveyor assembly comprising horizontal (or slightly inclined), vertical and/or inclined screw conveyors shall transfer the chemical from the splitting machine into the chemical hoppers. Waste bags discharged from the splitting machine shall be compacted into a plastic sack for collection and subsequent disposal. The splitting machine and associated equipment shall be fully enclosed for dust containing in operation. A dust extraction unit shall be provided to prevent dust from flying out of the system during operation.

The splitting machine and its associated equipment shall be fabricated from stainless steel grade 316 (termed as “stainless steel” hereafter).

## **3. ROLLER TABLE**

The roller table shall be formed from rollers with sealed-for-life bearings attached to a frame fixed onto the floor. The top of the roller table shall be about 1000 mm above the floor to facilitate manual loading and manoeuvring of chemical bags.

Unless otherwise specified, the roller materials, nominal roller diameters, tube thicknesses and spindle dimensions shall be in accordance with the requirements of BS 2567. The outside diameter of rollers shall not be less than 65 mm and the clearance between rollers shall be not less than 40 mm.

#### **4. INCLINED BELT CONVEYOR**

The belt conveyor shall be complete with flat rubber belt, carrying idlers, return rollers, head and tail drums, side guards, loading end guards and adjustable support legs, etc., suitable for handling chemical bags of dimensions as specified in the Particular Specification.

The usable width of the belt conveyor shall be not less than 500 mm. The belting material shall comply with the requirements of BS EN ISO 14890 and the belt edge clearance shall be in accordance with BS 8438.

The conveyor shall be designed to contain all the chemical powder escaped from the chemical bags so that no chemical powder would fall from the conveyor belt onto the floor during operation.

The belt speed shall be designed to match the capacity of the bag splitting machine as specified in the Particular Specification. However, in no circumstances a belt speed greater than 18 m/min shall be accepted. In the design of belt speed, the inclination of the belt conveyor shall be taken into account, and slatted belt instead of flat belt shall be used if the inclination of the belt conveyor together with the designed belt speed may render the chemical bags sliding down or tipping over from the conveyor.

Provisions shall be made in the design of the conveyor for maintaining the belt tension automatically and the adjustment of the tail pulley of the conveyor to ensure the squareness of the belt. Intermediate guide rollers shall be provided to keep the belt in alignment.

Bearings of all rolling elements of the conveyor shall be of the sealed-for-life type.

Each conveyor shall be driven by a geared electric motor which shall be integral with the head drum. The motor shall have a degree of protection of IP 55 to IEC 60034-5 and its design shall be suitable for intermittent operation. A mechanical overload protection and anti-run-back device shall be provided.

#### **5. CHEMICAL BAG SPLITTING MACHINE**

The chemical bag splitting machine shall be of robust construction requiring minimum maintenance and operator intervention during operation. Allowance shall be made to avoid excessive wear of the machine components due to the abrasive characteristics of the chemical being handled. Inspection doors shall be provided at each section of the machine to facilitate inspection and maintenance.

The splitting machine shall be suitable for handling chemical bags of various dimensions as specified in the Particular Specification. The splitting machine shall be capable of emptying at least 99 % of chemical powder from each bag.

The infeed section of the machine shall be equipped with a "swing door" type flapper arranged to seal the infeed opening, but shall be flexible enough to allow the bag to push through from the infeed conveyor.

The infeed section of the bag splitting machine shall be provided with rollers or a belt conveyor to ensure smooth transfer of chemical bags from the inclined belt conveyor system into the machine. A chute shall be provided to seal the junction between the inclined belt conveyor system and the bag splitting machine so that no chemical powder will fall out or spill onto the floor. Means shall be provided at the chute for brushing off chemical powder from the inclined belt and conveying it to the inlet chute of the screw conveyor system or other suitable location.

The splitting machine shall comprise a splitting section, a screening compartment and a gravity discharge chute.

The splitting process of the splitting machine shall be independent of the alignment of the feed bags. Allowance shall be made in the splitting process to accept bags travelling to the machine "skewed" as well as in line. Bag splitting machine requiring accurate alignment of chemical bags to the cutters for splitting will not be accepted.

The bag splitting section shall be completely enclosed by at least 2 mm thick stainless steel panel covers and fully gasketed. Side frames of the splitting machine shall be removable.

The bag splitting machine shall be equipped with stainless steel circular rotating cutters or helical screw cutters.

For machines with circular rotating cutters, the bags shall be cut from the upper and lower sides by means of at least four rotating cutters provided with two at the top and two at the bottom. Each rotating cutter shall be driven by a separate motor.

For machines with helical screw cutters, bag splitting shall be by means of circular cutter blades mounted on the outer edge of the helical bag splitter screw and a cutter panel with inclined chamfered cutter blades at the side of the bag splitting section. The helical screw cuts the bag and acts as a conveyor screw which presses the bag against the cutter panel and conveys the split bag to the next section.

Opening of bags shall be achieved by cutting instead of tearing. The cutters shall be designed to avoid production of fine fragments of chemical bag fabric which may contaminate the chemical.

Cutting methods using single-blade sawing through the chemical bags or with cutting blades attached to swinging arms and cutting along the edges of the chemical bags will not be accepted.

Chemical bags after being cut shall be transferred to the screening compartment. Chemical powder and bag fabrics shall be separated by an internal rotary separator installed inside the screening compartment.

The internal rotary separator shall be fabricated to rigid structural shapes and shall be complete with baffles and removable screen sections of mesh opening not greater than 20 mm x 20 mm.

The rotary separator assembly shall ride on four trunnion wheels having internal roller bearings of the sealed-for-life type.

The rotary separator shall comprise a series of internal baffles duly designed to empty the content of the chemical bag being handled and to help propel the bag fabric through the length of the screening section.

After emptying, the bag content shall pass through the rotating screen for gravity feed to a discharge chute leading to a screw conveyor for transferring the chemical to storage hoppers. The discharge chute shall be designed to promote continuous chemical flow towards the outlet. The sloped sides and the side interfaces shall be as steep as possible and shall be greater than the angle of repose of the chemical. An electric vibrator shall be provided if arching of chemical powder at the outlet of the discharge chute is anticipated due to the gentle slope of the outlet chute.

A suitable dust proof mechanical device for bag counting shall be installed at the infeed section of the splitting machine. In addition, interlock control shall be provided to stop the feeding of chemical bags to the splitting machine if the infeed chamber of the machine is blocked or the cutter of the splitting machine fails. An audible and visual alarm shall be provided near the conveyor belt loading position to indicate the failure of the splitting machine.

Elevated access platforms and ladders shall be provided for the operation and maintenance of the bag splitting machine.

## **6. HORIZONTAL SCREW CONVEYOR**

Horizontal screw conveyor shall be of trough type. Cross connections of horizontal and vertical screw conveyors for the formation of a chemical transfer system may be formed from tube type shell. The drive to the screw conveyor shall be by motor directly coupled to the drive-end gudgeon and bolted to a supporting stool forming the end plate of the conveyor. The flight of the screw conveyor shall be supported by sealed-for-life bearings. The motor shall have a degree of protection of IP 55 to IEC 60034-5.

Conveyor trough shall be covered by lids with lapped edges for stiffness. Lids shall seat on rubber or other suitable material to completely sealed off against the escape of dust and shall be secured by toggle catches of heavy industrial pattern. All joints shall be flanged and gasketed to prevent the escape of chemical dust.

Intermediate bearings shall be self-lubricating, carried on adjustable hangers, and capable of easy exchange of bushes. The spacing of intermediate bearings shall not exceed 2.5 m.

The sizing of the screw conveyor shall be such that when handling the rated capacity of the equipment discharging into the screw conveyor, the contents shall not flood the hanger bearing.

The flight of the screw conveyor shall be at least 4 mm thick fabricated from stainless steel strip and continuously welded to the shaft to form a varying pitch helicoid flight. Where outlets occur at the end of conveyors, the end flight shall be opposite-handed to prevent material packing into the end plate.

The choke section of the screw conveyor shall be at least two pitches long and the conveying section core shall have an increasing pitch to prevent packing. Close tolerance fit between screw flight and conveyor casing shall be adopted for the conveyor design to allow efficient feed of powdered chemical with minimum operating noise. To facilitate maintenance, seals and bearings shall be of easily accessible design.

## **7. VERTICAL/INCLINED SCREW CONVEYOR**

Vertical/inclined screw conveyor shall be of tube type complete with inspection openings at cross connections. The drive to the screw conveyor shall be by motor directly coupled to the drive-end gudgeon. The drive shall be either bolted to a supporting stool forming the end plate or flange mounted to the conveyor. The flight of the screw conveyor shall be supported by sealed-for-life bearings. The motor shall have a degree of protection of IP 55 to IEC 60034-5.

The conveyor tube shall be formed by continuously spiral welded stainless steel plate of not less than 5 mm thick and stainless steel inspection panels shall be at least 2 mm thick with lapped edges for stiffness. Inspection panels shall seat on rubber or other suitable materials to be completely sealed off against the escape of dust and shall be secured by toggle catches of heavy industrial pattern.

The flight of the screw conveyor shall be supported from intermediate bearings of the sealed-for-life design. The weight of the flight to be supported by the drive motor shall not be accepted. Purposely made brackets shall be provided and installed for the support of the screw conveyor. Arrangement shall be made to provide access for routine inspection, maintenance and removal of the flight of the screw conveyor.

The vertical/inclined screw conveyor shall be designed for transferring chemical powder from a low level to a higher level. Powdered chemical entering the receiving port shall be lifted by continuous rotation of the flight whereas the dropping shall be achieved by gravity. Chemicals shall be discharged at the outlet chute of the screw conveyor in the form of discharging duct at an inclined angle to the longitudinal axis of the conveyor. All joints shall be flanged and gasketed to prevent the escape of dust.

The direction of rotation of the screw conveyor shall be designed to suit the associated upstream screw conveyor such that powdered chemical shall be discharged at the side port and removed by the screw at the cross connection.

The flight of the conveyor shall be at least 4 mm thick fabricated from stainless steel strip and continuously welded to the shaft to form a varying pitch helicoid flight.



Close tolerance fit between screw flight and conveyor casing shall be adopted for the conveyor design to allow efficient feed of powdered chemical with minimum operating noise. To facilitate maintenance, seals and bearings shall be of easily accessible design.

## **8. BAG COMPACTOR**

Each bag splitting machine shall be equipped with its own bag compactor to reduce the volume of the waste bags to less than one sixth of the original volume. The empty bags shall be transferred to the bag compactor automatically without manual operation.

The bag compactor shall be of mechanical type or hydraulic type. A discharge nozzle shall be provided for transferring and compacting waste bags into a plastic sack. The discharge nozzle shall be not less than 400 mm in diameter, fabricated from not less than 6 mm thick stainless steel plate with a compactor transition section made of not less than 9 mm thick stainless steel plate.

The bag compactor shall be mounted on the floor to facilitate operation and maintenance. The compactor housing shall be fabricated of structural steel and steel plates. A bin with castors shall be provided at the bottom of the bag compactor to collect the residual chemical powder.

## **9. CHEMICAL DUST EXTRACTION UNIT**

Each bag splitting machine shall be equipped with its own dust extraction unit, which shall be designed in such a way that no dust of appreciable concentration or quantity is discharged to the atmosphere. The filtered chemical dust shall be returned directly to the screening section for a built-in unit. Should an external unit be provided, a dust bin of not less than 50 litres shall be provided at the bottom of the dust extractor for the collection of filtered chemical dust.

The dust extractor shall be of stainless steel construction. The unit shall include an electrically driven dust extractor, chemical dust filter elements, side access doors and cable termination box. Dust extraction motor shall not be located inside the dust extractor.

The dust extractor shall be of side filter bag removal type. Removal of the filter assembly shall be effected from the front of the unit through a hinged access door. The filter assembly shall comprise flexible inserts which shall maintain the form of the element under dynamic air flow conditions.

Filter elements shall be made of suitable chemical resistant material and certified to IEC 60335-2-69 Class L or better. Dust shall be removed from the filters by operation of a cleaning mechanism in the form of repulse air jets or vibration.

All electrical components shall be housed in enclosures with a degree of protection IP 65 to IEC 60529. Solenoid valves shall be manifolded. Each unit shall be furnished with electronic sequencing timer and air pressure gauge. A differential pressure indicator and switch shall be provided to the compressed air pipelines feeding the

extractor. A high differential pressure alarm shall be provided when cleaning or replacement of filter bag is required.

If the connection between the dust extractor and the chemical handling equipment is by air duct, sizing of the air duct shall be designed to have the dust particles to travel at an optimum speed of not less than 18 m/s.

## **10. CONTROL AND OPERATION SEQUENCES**

The operation of the system shall be automatic. Facilities for manual operation and control shall be provided on the front surface of the Chemical Handling Local Control Panel. When automatic mode is selected, the system shall function with minimum attendance. When in manual mode, each component shall be operated independently for the purpose of commissioning, testing and maintenance of the system.

When the system is in automatic mode of operation, the bag splitting process shall continue to the end of the normal bag splitting cycle and shall allow the system to re-start without the need for manual resetting of any components. An adjustable time delay of 3 - 30 seconds shall be provided between each bag splitting cycle to allow test runs to be made for the adjustment of components.

The inclined belt conveyor shall stop when there is a chemical bag being processed in the bag splitting machine and shall resume operation upon completion of emptying process. Continuous feeding of chemical bags is not allowed unless it is proved that such feeding of chemical bags will not overload the splitting machine and lead to process suspension.

The control system shall be designed to control the screw conveyors both automatically and manually.

Control interlocks shall be provided to stop the system operation should any equipment of the system trip or the contents of the hopper reach high level. The failed/trip equipment shall be reset manually before the system can be re-started.

The splitting machine shall be automatically shut down in the event that the bag compactor is stopped or any access door is opened.

## **11. MOTORS FOR PLANT DRIVES**

Induction motors supplied shall comply with the WSD Standard Specification E-51-04 and the following additional requirements:

- (a) Auxiliary control to energise the motor heater when the motor is not running and to de-energise it when the motor is running shall be provided.
- (b) Emergency stop push buttons shall be provided for all drives adjacent to the equipment. Devices installed shall have metal enclosure with a degree of protection IP 65 to IEC 60529.

- (c) Motor rated output shall be not less than 120% of the maximum power absorbed by the load specified/designed for, except that 100% rated motor output shall be acceptable under the following conditions:
- (i) Standard industrial units such as mass manufactured drives with non-overloading characteristic, and the peak load not exceeding 100% of the rated motor output, or
  - (ii) MCR motors used for intermittent load, with operating time not exceeding 15 minutes each hour, and the peak load power not exceeding the MCR load rating.

## 12. **CHEMICAL HANDLING LOCAL CONTROL PANEL**

A floor standing Chemical Handling Local Control Panel shall be provided. The control panel shall comply with WSD Standard Specification E-11-03. In addition, transparent dust cover shall be provided for the protection of display and control components. The panel shall be designed to provide logic control of the inclined belt conveyor system, bag splitting machine, bag compactor, dust extraction unit, screw conveyor system and monitoring instruments to form a complete working system.

The control panel shall contain as a minimum the following controls, indicators and annunciators to facilitate monitoring, automatic and manual control of the bag splitting machine.

- (a) The panel enclosure shall be made of grade 316 stainless steel with a degree of protection IP65 to IEC 60529. Viewing windows with hinged acrylic glazed panel cover shall be fitted over the front surface of the control panel for the dust protection of display and control components.
- (b) Indicating lamps for the equipment in operation, equipment tripped alarms, service hopper full, system on/off/failed and automatic mode selected shall be provided on the front surface of the control panel. LED indicating lamps complying with IEC 60947-1 and IEC 60947-5-1 shall be used. They shall have a protection rating of IP54 for indoor or IP65 for outdoor / chemical process area to IEC 60529. The colour coding for the indicating lamps shall be as follows:

<u>Indicating Lamp</u>	<u>Colour</u>
Motor on	Green
Motor off	Red
Motor tripped	Red
Valve open	White
Valve closed	Blue
Service hopper full	Red
System on	Green
System off	Red
System failed	Red
Auto selected	White

- (c) A resettable bag counter with 4 digits for recording the number of bags emptied shall be provided on the front surface of the control panel.
- (d) The following selector switches and the corresponding labels shall be included:

<u>Label</u>	<u>Selection</u>
Hopper selector switch	Hopper 1/2
Duty selector switch	Auto/Off/Manual

- (e) Push buttons

When the duty selector switch is in auto mode, the system shall be started/stopped by the “System On” / “System Off” push-buttons.

When the duty selector switch is in manual mode, “Start” / “Stop” push buttons shall also be provided for independent manual operation of the rotary separator, each bag cutting knife, bag compactor, conveyors and dust extraction unit.

A black “Lamp Test” push-button, and a red mushroom headed stay-put type “Emergency Stop” push-button to halt the chemical handling plant in case of emergency shall be provided.

- (f) An alarm buzzer, a yellow “alarm accept” push-button and a black “alarm reset” push-button shall be provided.
- (g) Motor starters, control relays, fuse and links etc, shall be provided for the ancillary drives. Equipment for each drive shall be arranged in a group and distinctively labelled for easy identification.
- (h) A main isolating switch for the control panel shall be provided. The switch shall be fitted with mechanical “ON” and “OFF” position indicators and facility for padlocking at the “OFF” position. Mechanical interlock shall be fitted to prevent access to the interior unless the switch is in the “OFF” position.
- (i) An anti-condensation panel heater complete with a humidity sensor and an 16A double pole isolating switch shall be provided.
- (j) Terminals complying with the requirements of IEC 60947-7-1 and gland plate for external power and control cables shall be provided.
- (k) Provisions of interfacing circuits with other treatment plant monitoring systems shall include:

Volt-free contacts for incoming circuits

- “service hopper full”

Volt-free repeat contacts for outgoing circuits

- “system on”
- “system off”

- “system failed”
- “system auto selected”

### **13. INSPECTION AND TESTS**

Inspection, testing and reporting for the chemical bag splitting machine and accessories shall be in accordance with WSD Standard Specifications EM-00-01 and EM-00-03.

Upon completion of installation of the bag splitting machine, a performance test including verification of bag cutting capacity of the machine is required to be carried out by the Contractor under the supervision of the manufacturer’s representative and the test report shall be submitted to the Engineer for approval.

In particular, the sequence of the complete operation cycle and response of each control switch, push button, relay, timer, indicating lamp, alarm indicator and monitoring device of the control panels shall be individually checked for its correct function.

- End of Specification -