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Electrode Extruder Using Screw Conveyor

S. Seshagiri

Design Engineer, WEG Industries India Pvt. Ltd. Hosur, Tamilnadu, India.
sseshagiri4@gmail.com

M. Krishna moorthi*

*PG scholar, Dept of Thermal Engg. Govt. College Of Tech. Coimbatore, Tamilnadu, India.
krishnamoorthygct@gmail.com

Abstract—
Welding electrodes are metal wires with chemical coatings. It is widely used in arc welding process. The metal rod is used to sustain the welding arc and to provide the filler metal required for the joint to be welded. The coating protects the metal from damage due to oxidation, stabilizes the arc, and improves the weld. Our paper is concerned with the design and fabrication of manually operated device that produces such welding electrodes. It follows the extrusion principle and screw conveyor concept. It is done by passing the electrode and the flux material through a die. It is a simple setup from which electrodes can be manufactured easily.

Keywords— welding electrode; screw; flux; nozzle

I. INTRODUCTION

1.1 Method of Producing Coated Electrodes:

There are two methods of applying flux coating on the core wire,

(a) By dipping,
(b) By extrusion.

Extrusion method is very fast and economical; produces strong uniform and concentric coatings and has largely replaced the dipping process.

Dipping Method:

Number of core wires cut to definite length is clamped vertically in a fixture and are dipped in a bath of molten flux. When a suitable thickness of the flux gets adhered to the core wire, the fixture is raised and the flux is allowed to dry.

Extrusion Process:

Coating ingredients are mixed up in desired quantities, binder (often sodium silicate) is added and the resultant mass is brought in the form of a thick, viscous, stiff paste. This paste is shaped in the form of a cylinder which is fed into the extrusion press. Core wire and thick paste of flux simultaneously under pressure pass through a die, thus attaching the flux coating on the core wire. The coating thickness depends upon the die opening and can be varied. As a next step the flux from the gripping end of the electrode is removed by an electrically rotated wire brush; after which the electrodes are fed to ovens where they are dried and baked to remove excess moisture.

1.2 Welding Electrode Extruder:

It is a simple manually operated device used for the production of welding electrodes. Here a screw conveyor rotating inside a cylindrical barrel is used. In this the bare electrode and the coating material are allowed to pass through a die and thus coating is done. This follows the extrusion process**.** The operation of the device is very simple. The bare electrodes are continuously fed into the hollow shaft by rollers and the flux material is poured into the barrel through a funnel. The hollow shaft which has metal flights over it, is driven manually by a set of bevel gears. At the front end of the device there is a nozzle which acts as the die. When the electrode and the flux material come out of the die, the flux sticks on the bare rod. Thus the electrode gets coated. The coated electrode is guided by two rollers. The gripping end of the electrodes can be ground later after removing it from the rollers. This is an innovative method of producing coated electrodes. Any kind of flux material can be poured into the funnel and the required coating can be done.

1.3 Types of conveyor:

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in

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applications involving the transportation of heavy or bulky materials.

The different types of conveyors are given below:

- Belt conveyor
- Screw conveyor
- Apron and mold conveyor
- Feeders and vibrating conveyor
- Bucket conveyor

Screw Conveyor:

A screw conveyor or auger conveyor is a mechanism that uses a rotating helical screw blade, called a "flighting", usually within a tube, to move liquid or granular materials. They are used in many bulk handling industries. Screw conveyors in modern industry are often used horizontally or at a slight incline as an efficient way to move semi-solid materials, including food waste, wood chips, aggregates, cereal grains, animal feed, boiler ash, meat and bone meal, municipal solid waste, and many others.

The various parts of the screw conveyor is given below

SCREW

The helicoids type of this is made by cold rolling a continuous strip to form a helix of desired diameter, pitch, and thickness, to fit a given size pipe or shaft.

Fig.1 photograph of Screw Conveyor

BARREL

Screw conveyor is placed inside barrel. Screw conveyor should rotate freely without any disturbance.

BEARING

Bearing is used to support the screw conveyor. It is equal to the inner diameter of the barrel.

NOZZLE

Nozzle is attached at the exit of the barrel. The exit of the nozzle is equal to outer diameter of electrode.

2. WORKING METHOD

Screw conveyors or spiral conveyor are installations serving to move materials over a U-shaped trough or a tubular casing by rotating a helical plate screw or worm. The friction between the material and the trough as well as its own weight prevents the material contained between the flights from rotating with the screw. Thus the movement of the material mass is analogous to the translating motion of a non-rotating nut when the screw is driven. The direction of conveying can thus be easily determined for a given helix direction of the screw and its direction of rotation. Due to the frictional drag of the rotating screw on the material particles, the material mass shifts towards the direction of rotation. If the material filling is high and the screw speed is high, the material particles in the neighborhood of the screw shaft tend to rotate along with the shaft thus resulting in loss of capacity. Hence screw conveyors are usually operated with partial filling of the available space (40 to 45% maximum) and at limited speeds. The helical blade forces the load along the trough, when the shaft is set rotating. The screw blade is made of steel plate and is attached to the shaft by welding. The screw may even be of cast construction.

Advantage of having screw conveyor:

- They are relatively inexpensive, easy to maintain, convenient in intermediate unloading.
- Screw conveyors, by virtue of design ensuring gas-tightness, are widely used to handle dusty or hot loads and those which liberate harmful gases and unpleasant odors.
- They readily move fibrous materials.
- They are compact and easily fitted into close quarters.
- They can operate in horizontal, vertical or inclined path, although the carrying capacity is reduced as the slope increases.
- The trough can have top covers to form a seal and retain the material or prevent ingress of moisture or contamination.

Disadvantage:

- Vertical spirals are most limited in their application. They may invite difficulties when the load is abrasive, slumping, coarsely broken or sticky.
- Stringy material is not suitable for handling by screw conveyors.
- The other drawbacks are high unit power consumption.

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4. DESIGN OF WELDING ELECTRODE EXTRUDER

Design of screw:

Inner diameter of barrel = 12 mm
Outer diameter of screw=58 mm
Clearance between screw and
Barrel=1 mm

Amount of flux to be coated:

Volume V $= \pi/4 \times D^2 \times L$

$= \pi/4 \times (2\times10^{-3})^2 \times 0.450$

$= 1.413 \times 10^{-6}\ m^3$

Mass of flux to be coated, $m = \rho \times V$

$= 1746 \times 1.413\times10^{-6}$

$= 0.0024$ Kg

Capacity, Q = 0.0024 Kg/min
= 0.0024 x 60
= 0.1480 Kg/hr
= 0.1480×10^{-3} tonnes/hr

Capacity of screw conveyor,

$$Q = 15 \times \pi \times D^2 \times S \times n \times \psi \times \rho \times C$$

Diameter (D) = 0.055 m
Pitch (S) =0.9*D
=0.0495 m
Ψ =0.4

W.K.T $Q = 15 \times \pi \times D2 \times S \times n \times \psi \times \rho \times C$

n =Q/ $(15 X \pi \times D2 \times S \times \psi \times \rho \times C)$
=0.1480x10-3/

$(15 \times \pi * (0.055)^2 \times 0.4 \times 0.0495 \times 1.746 \times 1)$
n = 0.0300 rpm

Design of Barrel:

Outer diameter of barrel = 65 mm
Inner diameter of barrel = 60 mm
Length = 610 mm

Design of nozzle:

1. Cone

Small diameter = 6mm
Larger diameter =65mm
Height =120mm

2. Hollow pipe

Outer diameter =72mm
Inner diameter =67mm
Length = 50mm

3. Hollow tube

Outer diameter =10mm
Inner diameter =6mm
Length = 70mm

Design of Handle:

Diameter of shaft =25mm
Length of shaft =100mm
Length of plate =150mm
Length of handle =100mm

Design of feed Rollers:

Roller

Outer Diameter =40mm
Inner Diameter =10mm
Length = 25mm

Shaft

Diameter =10mm
Length =70mm

Fig.2 Bevel Gear & Handel Mechanism

Fig.3 Photograph of electrode extruder

Fabrication of Welding Electrode Extruder:

Fabrication as an industrial term refers to building metal structures by cutting, bending, and assembling. In this chapter, the fabrication of the different parts of the conveyor is explained.

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Fabrication of Screw:
The screw is fabricated by welding a steel sheet around the hollow tube in a helical manner. The sheet to be welded is cut to the required dimension. The pitch is marked on the hollow shaft and the reference helix is drawn. The sheet is placed over the reference and welding is done.

Fabrication of Barrel:
A hollow pipe of the required diameter is cut to the required dimensions. A hole is drilled near one end of the barrel, for welding the funnel.

Fabrication of Nozzle:
A cone is formed from steel sheet. It is then welded to a hollow pipe at the larger end. A small hollow tube is welded at the smaller end of the cone. The slag is then removed by filing.

Fabrication of Bushes:
Two rollers are machined using lathe machine. The rollers are grooved in order to guide the electrode. The rollers are attached individually to two shafts. These shafts are connected to two plates by means of bolt and nut. A handle is welded to one of the rollers to give the drive.

Assembling of Welding Electrode Extruder:
The screw is inserted inside the barrel. The bearings are inserted inside the bushes by push fit. Then these bearings are attached in between the barrel and the screw. The nozzle is attached to the front end of the barrel. The nut is welded to the nozzle and it is then fitted to the barrel by screwing the bolt through the nut. A pair of bevel gears is set to drive the screw conveyor. One bevel gear is welded to the screw shaft and the other gear is held perpendicular to it by means of a stand. A handle is attached to the other gear through which the screw is rotated. Two guides are fitted to the front end in order to guide the coated electrode that is extruded out of the nozzle. The roller mechanism is fixed at the rear end with help of nuts and bolts. The whole set up is welded to a stand.

5. Conclusion:
We have designed and fabricated a manually operated welding electrode extruder. This device is compact and portable. This project is very helpful in producing electrodes for small scale production. It can be easily operated and it is simple in construction. The coating material or the flux can be changed according to the manufacturer's desire. Thus this device is very useful in coating flux over the electrodes of desired composition. In future, we can upgrade this device by automating it with the help of a motor. This will help make it suitable for large scale production. Also the coating diameter can be varied by making the nozzle exit diameter adjustable. Thus it can produce lightly coated or medium or heavily coated electrodes. Further, the bare electrode or wire can be fed from a spool and this will be very useful for continuous production. In such case, a separate cutting mechanism should be fitted on the front end in order to cut the electrode to the desired length. A heating chamber may also be incorporated in the path of the extruded electrode for instant setting of the coated flux material.

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