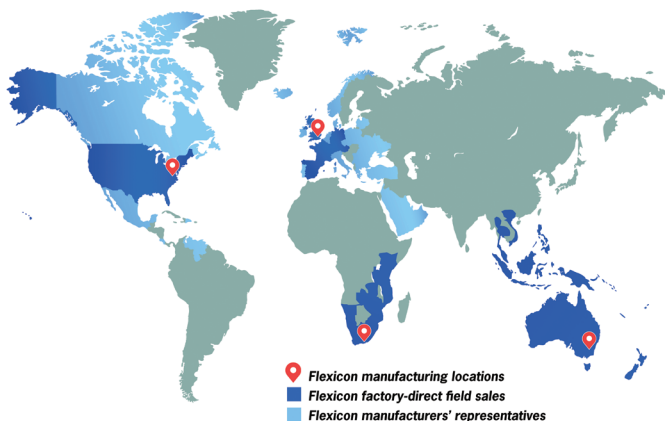




*Powdered milk emptied from bags into bag dump station flows through 48 in diameter circular vibratory screener into Flexicon floor hopper, from which flexible screw conveyor, at a 45-degree incline, transports the powder to form-fill-seal machine in adjacent room.*

## Flexible Screw Conveyor, Circular Separator Help Package Powdered Milk at High Rates

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● Flexicon manufacturing locations  
■ Flexicon factory-direct field sales  
■ Flexicon manufacturers' representatives

# flexicon®

### USA

FLEXICON CORPORATION  
Tel: +1 610 814 2400  
E-mail: [sales@flexicon.com](mailto:sales@flexicon.com)  
Web: [www.flexicon.com](http://www.flexicon.com)

### UK

FLEXICON (EUROPE) LTD  
Tel: +44 1227 374710  
E-mail: [sales@flexicon.co.uk](mailto:sales@flexicon.co.uk)  
Web: [www.flexicon.co.uk](http://www.flexicon.co.uk)

### AUSTRALIA

FLEXICON CORPORATION  
(AUSTRALIA) PTY LTD  
Tel: +61 7 3879 4180  
E-mail: [sales@flexicon.com.au](mailto:sales@flexicon.com.au)  
Web: [www.flexicon.com.au](http://www.flexicon.com.au)

### SOUTH AFRICA

FLEXICON AFRICA (PTY) LTD  
Tel: +27 41 453 1871  
E-mail: [sales@flexicon.co.za](mailto:sales@flexicon.co.za)  
Web: [www.flexicon.co.za](http://www.flexicon.co.za)

### SPAIN

FLEXICON EUROPE SPAIN  
Tel: +34 930 020 509  
E-mail: [ventas@flexicon.es](mailto:ventas@flexicon.es)  
Web: [www.flexicon.es](http://www.flexicon.es)

### FRANCE

FLEXICON EUROPE SAS  
Tel: +33 7 61 36 56 12  
E-mail: [ventes@flexicon.fr](mailto:ventes@flexicon.fr)  
Web: [www.flexicon.fr](http://www.flexicon.fr)

### GERMANY

FLEXICON EUROPE GmbH  
Tel: +49 173 900 78 76  
E-mail: [vertrieb@flexiconeurope.de](mailto:vertrieb@flexiconeurope.de)  
Web: [www.flexicondeutschland.de](http://www.flexicondeutschland.de)

### SINGAPORE

FLEXICON SINGAPORE PTE LTD  
Tel: +65 6778 9225  
E-mail: [sales@flexicon.com.sg](mailto:sales@flexicon.com.sg)  
Web: [www.flexicon.com.sg](http://www.flexicon.com.sg)

### INDONESIA

FLEXICON SINGAPORE PTE LTD  
Tel: +62 81 1103 2400  
E-mail: [sales@flexicon.co.id](mailto:sales@flexicon.co.id)  
Web: [www.flexicon.co.id](http://www.flexicon.co.id)

## Flexible Screw Conveyor, Circular Separator Help Package Powdered Milk at High Rates

BREVARD, NC — Transylvania Vocational Services (TVS, Inc.) needed to unload 55-lb bags of dry powdered milk having various densities, convey it, and package it in 2-lb bags at a rate of 90 lb/min.

The solution consisted of a 48-in square bag dump station through which two workers unload powder that falls into a 48-in diameter circular vibratory separator. The separator scalps paper pieces from cut bags containing the powdered milk product. The powder falls from the screener's discharge outlet into a 25 cu ft capacity Flexicon floor-mounted hopper. A 15-ft long Flexicon flexible screw conveyor, at a 45-degree incline transports the powder through an interior plant wall to a filler and vertical form-fill-seal packaging machine in the adjacent room.

"The flexible screw conveyor was the easiest method for conveying in this confined space," says Hendrik Colijn, consulting engineer on the project.

Becky Alderman, TVS director of operations, in describing the large components needed to meet the 90 lb/minute flow rate, explains, "We super-sized the line." A 10-hp motor drives the flexible screw conveyor to draw the high flow of powder through its 6-in diameter." Charles Merrill, food operations manager, adds, "We need the high throughput to satisfy our contract requirement of packaging 16 million pounds per year."

Built to 3-A dairy standards, the system operates in a temperature and humidity controlled clean room required for USDA dairy certification. Temperature is maintained between 70° -72°; humidity between 27-35% for the dry product (2.5% – 3% moisture). "Moisture over 3% causes trouble for the packaging machinery," Merrill says.

### Varying Densities Difficult to Handle

The unloading system needed to handle dry milk whose density ranged from 30 to 40 lb/cu ft, at the 90-lb/minute flow rate. "We're packaging one of the worst products for packaging machines," Merrill continues. Bulk densities change without notice, even in one pallet load, as 55-lb bags of dry milk powder arrive from USDA warehouses from a multitude of suppliers. The varying density requires constantly adjusting the filler and vertical form-fill-seal machine.

The circular vibratory screener and flexible screw conveyor, however, remain largely unaffected by the bulk density variations.

The low-profile circular vibratory screener is equipped with two externally-mounted vibratory motors. The motors impart multi-plane inertial vibration to two spring-mounted screening decks, causing oversize particles to vibrate across the screen surface in controlled pathways to the screen periphery where they are discharged. Screening efficiency improves by forcing the powder to pass over a maximum amount of the 8-mesh size screen surface. The 0.0027-inch particles pass rapidly through the screen and bottom frame discharge.



*Powdered milk emptied from bags into bag dump station flows through 48 in diameter circular vibratory screener into Flexicon floor hopper, from which flexible screw conveyor, at a 45-degree incline, transports the powder to form-fill-seal machine in adjacent room.*

The flexible screw conveyor moves the powder through its UHMW polyethylene outer tube enclosing a rugged, flexible stainless steel screw. The flexible screw is the only moving part contacting material, assuring cleanliness. As it rotates in the tube, the flexible screw self-centers to provide clearance between the screw and tube wall to prevent grinding or crushing of the product.

To promote flow of the powder into the flexible screw conveyor's intake adapter, a vibrator in the floor hopper is manually adjusted according to the powder's density. Additionally, the hopper is designed with a steep back wall, and side walls that are skewed outward at divergent angles, reducing the ability of non-free-flowing materials to establish a bridge between the hopper side walls, instead causing it to topple and flow toward and down the back wall.

## **The Operation**

Workers on a 10-ft high mezzanine remove bags from a pallet, vacuum the bags, and slide them onto a conveyor belt, which moves them to the lip of the bag dump station. Two workers cut open the bags and pour the contents into the bag dump station.

Ambient air and dust from dumping activities are drawn onto the exterior of two cartridge filters that derive vacuum from a top-mounted exhaust fan. Dust accumulated on the filters' exterior surfaces is dislodged by overcoming continuous negative pressure within the cartridge filters, with positive pressure introduced in short blasts on a timed cycle by pulse jet nozzles. Dislodged material falls into a bin for return to TVS's dust collection system.

## **Timed Bag Dumping**

To avoid overloading the system and discharging milk powder from the screener as waste, workers must avoid dumping bags too rapidly. TVS trains workers to control their dumping rate and to stop or resume dumping when a light is activated by high-level sensors located at the flexible boot connecting the separator to the hopper, and atop the flexible screw conveyor, and a low-level sensor in the floor hopper. "The sensors and training of workers have decreased waste tremendously," Merrill says.

TVS operates the packaging line on two shifts and cleans on the third shift. The separator is vacuumed according to 3A standards. "The screen usually stays clean with minimal material remaining," Merrill says.

Prior to cleaning the flexible screw conveyor, a worker removes the cleanout cap, and reverses screw rotation to evacuate any residual material. The screw and outer tube remove for cleaning. The conveyor has no cracks, crevices that can trap particles or prevent thorough cleaning.

TVS is a non-profit community rehabilitation program providing employment and employment services to adults with disabilities or other barriers to employment. Based on the success of this new line, TVS plans to add a sister unloading and packaging line that will blend milk powder and other ingredients. The system will incorporate another circular vibratory separator and two flexible screw conveyors.



### **USA**

FLEXICON CORPORATION  
Tel: +1 610 814 2400  
E-mail: [sales@flexicon.com](mailto:sales@flexicon.com)  
Web: [www.flexicon.com](http://www.flexicon.com)