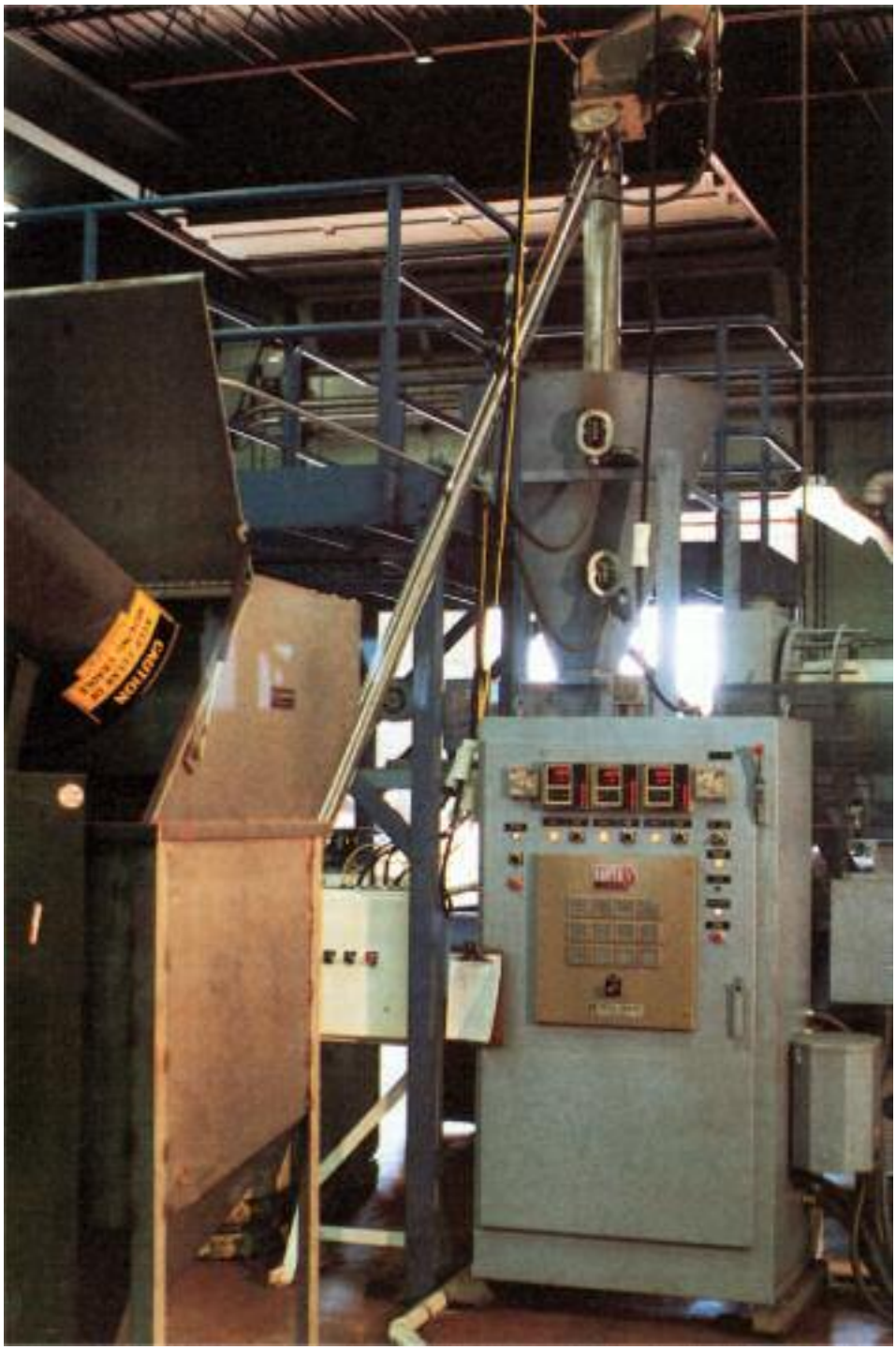
Case history

Conveyor with knife-edge helical screw meets ferrite manufacturer's conveying needs

Rather than elevate drums of abriasive material 14 feet to a rotary calciner, a ferrite manufacturer installed a spiral conveyor to lift the material.

Ceramic Magnetics, Fairfield, N.J., manufactures professional ferrites used for high-technology magnetic applications in the aerospace, communications, military, computer, and commercial electronics industries. The ferrite manufacturer mass produces standard and state-of-the-art ferrite products and creates unique prototypes.

The ferrite manufacturer receives raw materials by trucks delivering pallet loads of bags and barrels. The raw materials are reagent-grade submicron powders such as iron oxide, zinc oxide, manganese oxide, and manganese carbonate. During manufacturing, workers proportion the raw materials using digital scales and transfer the materials to a large high-shear mixer. The mixer blends the raw materials with deionized water,



The ferrite manufacturer's powdered raw materials enter the floor hopper (left), travel up the spiral conveyor (angled tube), and discharge into the rotary calciner's receiving hopper.

A ferrite manufacturer selected an enclosed spiral conveyor to elevate a blend of abrasive raw materials.

forming a slurry that's pumped into stainless steel drying trays in an oven. After drying overnight, the material cake in the trays resembles a dried river bed.

The material cake enters an oscillating granulator, which has a chamber with inward-tapered sides, bars on a central drive shaft, and a screen. The material enters the chamber and flows down the tapered sides past the bars. The central drive shaft rotates the bars 180 degrees and oscillates them, forcing the material between the bars and the screen.

The material exits the granulator and is stored in fiber drums that are then emptied into a conveyor leading to a calciner. The material is calcined at 1,050°C, resulting in a ferrite powder. A steel-ball mill wet-mills the ferrite powder in deionized water for about 12 hours. A tray dryer then dries the milled material for 24 hours before it's again granulated and screened. The ferrite powder is isostatically pressed into bar, rod, and disc shapes weighing up to 50 pounds each. Kilns heat the ferrite shapes to about 1,350°C. Finally, the ferrites are intricately machined to order.

The spiral conveyor's drive motor and discharge are suspended above the ferrite manufacturer's rotary calciner.

New rotary calciner requires material to be elevated

In 1987, the ferrite manufacturer installed a new rotary calciner, which is essentially a 16-inch-diameter tube that rotates within an oven. Due to the calciner's configuration, material would be transferred from fiber drums up 14 feet to the calciner's receiving hopper. Rather than elevate the filled fiber drums, the ferrite manufacturer decided to install an inclined conveyor.

The ferrite manufacturer then considered conveying options. "We considered just about anything you could think of," said Ceramic Magnetics technical vice president Larry Van Dillen. The ferrite manufacturer eventually decided to install a spiral conveyor.

"We chose the most economical solution — both the capital and operating costs are lower," Van Dillen said. "The spiral conveyor also has few moving parts, which is certainly an advantage; we don't want to pick up any metal contamination from a conveying device. And the conveyor is enclosed, which keeps any shop or shop floor contaminants out of the material. Stainless steel construction is also an advantage. The conveyor is easy to use and clean."

Tests verify spiral conveyor's capabilities

In 1987, the ferrite manufacturer contacted the manufacturer of a spiral conveyor called the Spiralfeeder® and provided material and conveying specifications. Full production

with the new rotary calciner was scheduled to start in 2 months.

For conveying tests, the ferrite manufacturer delivered a material sample with a 70-lb/ft^3 bulk density, a 100-mesh average particle size, and sluggish flow characteristics. From past experience conveying iron oxide — a major component of the material sample — the manufacturer knew that using either a flat or round helical screw would result in material buildup on the outer conveying tube's inner wall. The buildup would reduce the screw's clearance and eventually jam the conveyor, often in less than 30 seconds of operation. Based on laboratory tests of a new screw design, the manufacturer used a knife-edge helical screw (Figure 1), which cleans off conveying tube buildup using a ground, beveled edge. A 3-inch-diameter spiral conveyor was used to meet the required 100-ft3/h conveying rate.

A process engineer from the ferrite manufacturer witnessed the successful material conveying tests, which confirmed the material sample's conveyability and, through a series of 10 tests, confirmed conveying rates over 100 ft3/h. A hopper vibrator was the only flow aid required during testing.

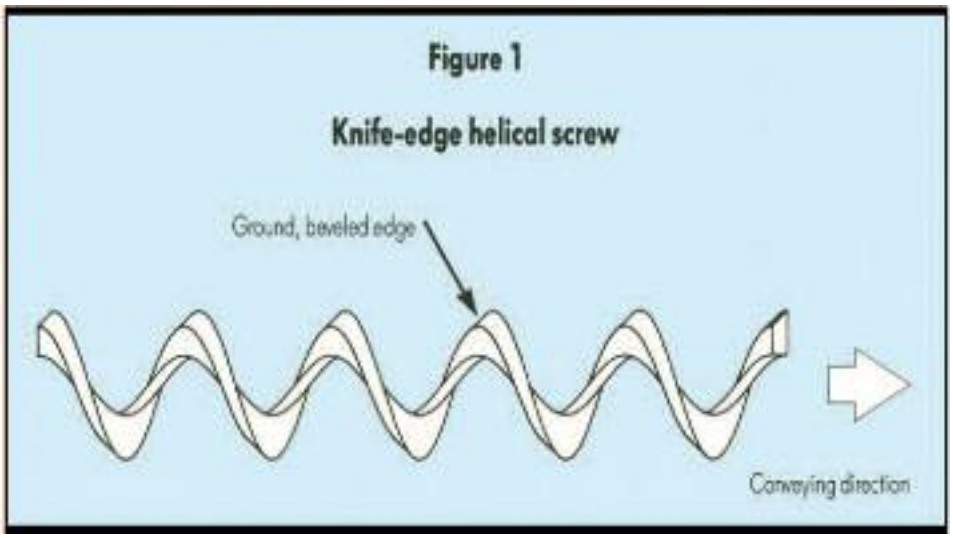
Ferrite manufacturer purchases equipment

Based on conveying tests, Ceramic Magnetics purchased a high-level drum dumper, a 20-cubic-foot floor hopper with a dust hood, a spiral conveyor with 3-inch conveying tubes, a motor control station, and an electric vibrator. The system was designed dust-tight with material contact sur faces of Type 304 stainless steel to prevent contamination.

A ferrite manufacturer's spiral conveyor has been successfully conveying abrasive materials since 1987.

The high-level drum dumper lifts and dumps fiber drums of material into the spiral conveyor's floor hopper. The hopper's square-sided top attaches to an inverted-pyramid-shaped bottom. The equipment manufacturer extended a standard 8.5 cubic-foot hopper's sides to achieve the floor hopper's required 20-cubic-foot capacity. The hopper has a 29⅝-inch-square safety grate and an angled swinging door with return air cylinders. The dust hood uses a 1.5 horsepower, 3,450-rpm motor, a cartridge filter, and a blowback baffle. The vibrator is water-tight and provides a maximum force of 80 pounds. The hopper's material outlet couples to the spiral conveyor's inlet.

The outlet of the spiral conveyor's helical screw couples directly to a drive motor and rotates concentrically between stationary inner and outer conveying tubes. The helical screw's pitch and rotation propel the material between the inner and outer tubes and toward the outlet.



The motor control station includes a NEMA 12 dust-tight enclosure with a reversing magnetic motor starter for the conveyor. The station interfaces with a high-level switch in the calciner's receiving hopper and a low-level switch in the floor hopper. The control station automatically triggers a refill of an empty receiving hopper and shuts off the conveyor when the floor hopper is empty. Another control station interface runs the electric vibrator only during conveying. The control station is mounted on a freestanding support frame.

The equipment was delivered to Ceramic Magnetics within 5 weeks of the order and was in operation 1 week later.

Spiral conveyor operates reliably

The conveying equipment has been sucessfully operating since 1987 at the ferrite manufacturer. "The equipment manufacturer helped us design the equipment and provided service," Van Dillen said. "It's worked well."

Ceramic Magnetics maintenance superintendent Albert Perkins said, "Considering what the conveyor is handling, it's doing a very good job. It runs unattended 24 hours a day because we rigged up a timer so the conveyor feeds the calciner overnight. A guy will stop by periodically and look up and say 'Yeah, it's there, it's feeding, everything's fine.'

"As far as performance goes, the conveyor's been excellent. Iron oxide generates powder that's like a fine lapping compound and loves to eat stuff up. With stainless conveyor, iron oxide will try to lap it out. This conveyor's held up quite well." **PBE**

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An equipment manufacturer used a knife-edge helical screw to prevent iron oxide buildup in a spiral conveyor's conveying tube.