

## TECHNOLOGY NEWS

## RECYCLING

## Unique Recycling Technology Debuts

Phillips Plastics Recycling Partnership has invested nearly \$5 million so far in its 18-million-lb/yr plastics recycling business in Tulsa, Okla., which started up in December. This expenditure, for a single recycling line in an existing building, would buy two of most other commercially available recycling systems. But this is the first production-scale installation of an unusual proprietary line that appears to have several advantages over standard commercial designs. The technology, which is available for license, was developed on a pilot scale by Partek Corp., a Vancouver, Wash., recycler. In 1990, Partek formed the recycling partnership with Phillips 66 Co., Bartlesville, Okla., which recently increased its stake in the venture from 51% to 75%.

The Tulsa plant, which will likely go

to seven-day, 24-hr production later this month, produces 100% post-consumer pellets under the "New Horizon" trade name. Blends of post-consumer recycle and a new high-ESCR virgin HDPE are also in development, says partnership managing director Tim Taylor.

The recycling line is based primarily on technology from the food-processing industry, distinguishing it from much plastics recycling technology, which has been borrowed from grain processing or mining. Above all, hardly any components of the line, except the conveyors and a spin dryer, are off-the-shelf equipment. "No one company made all of any one component. It's all custom built," says Leroy Johnson, president of BEST Engineering, Anaheim, Calif., which handled engineering and project management to scale up

from Partek's working prototype to the commercial plant. Several components and the overall process concepts have patents pending.

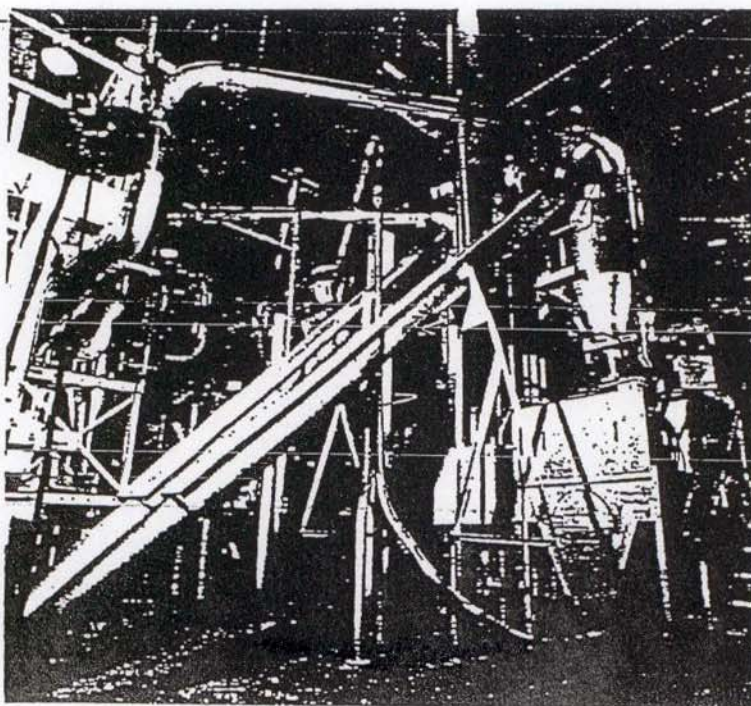
The heart of the recycling line is a proprietary granulator that produces a unique, highly uniform, square flake. These 0.5-in.-sq flakes have four major advantages over the irregular flake particles produced by ordinary rotary knife-mill granulators, which chop willy nilly and control size only after the fact by screening out everything bigger than a certain hole size.

First and foremost, the big square flakes are integral to the machine vision technology the partnership is developing to sort different colors automatically. The technology (an adaptation of color sorting used in the food industry to cull peas and beans) will be used as

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a quality check for stray colored milk-jug caps in the natural HDPE recycle that Phillips/Partek is concentrating on at the moment. Eventually, Phillips hopes to be able to process mixed detergent bottles, using a combination of automatic color sorting of whole bottles before granulating and color sorting of chopped flake as a last quality check just before the extruder. For now, the color sorting equipment in Tulsa is an off-line experimental setup, but would ultimately be integrated into the system, via air-veying tubes, just before the final extrusion



Another advantage of Phillips' single-pass granulation technology is minimal production of fines and dust. Partek president Victor Bitar says the fines level is "less than 5% by weight of the fines in regular plastic grind." The line does have dual aspirators to remove dust, but needs on-

The heart of Phillips/Partek's new recycling plant is its unusual 'single-pass' granulation of 1/2-in.-sq. flake. Two granulators (rear) process up to 2500 lb/hr each, making remarkably little fines, dust



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ly one dust-collection filter bag, unlike several other commercial systems, in which dust and fines production are far greater. The sludge filtered from the water-treatment system and label fragments taken off after drying contain minimal fines (though the vacuum process inadvertently draws off some whole flake as waste with the labels).

Large flakes translate into improved washing and drying economies because of fewer wetted surfaces—like the difference in time and energy to wash two large plates versus four small. (Union Carbide Corp.'s newly installed Sorema recycling equipment in Bound Brook, N.J., makes large flakes for the same reasons, but the flakes are irregular). The Partek technology also saves the high cost of noise suppression needed with conventional grinders.

Partek's original prototype line in Vancouver included granulation, washing, kinetic cleaning and color sortation

**The flake technology also saves the high cost of noise suppression needed with conventional grinders.**

technologies as developed by engineer Parry Teeny of Teeny Designs Inc. in Portland, Ore. (which has since assigned all rights to the Phillips/Partek partnership). TDI is a machinery design arm of Teeny Foods, a wholesale bakery, which designs its own processing equipment, hence the influence of food processing on granulation and color sorting concepts.

## SOPHISTICATED COMPUTER CONTROLS

A major contribution to the success of the commercial plant came from BEST Engineering. It's the design of an elaborate computerized process-control and pneumatic material-handling system. The process has some 780 electronic sensors plus a bank of custom-designed mechanical controls, says recycling plant manager Dale Polk.

The entire process is controlled by an IBM 386 computer with color CRT monitor and interfacing custom software also developed by BEST Engineering. The control program includes 20 screen displays for visualizing sections of the line, with touchscreen control of temperatures, residence times and throughput rates, so an operator can vary processing conditions for different materials or levels of contamination. This pass-

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word-protected program also has 10 screens of production data, such as materials inventory, resin additives, and work-in-process inventory.

## HOW THE LINE OPERATES

The Phillips partnership buys baled, presorted post-consumer HDPE bottles through long-term contracts in the region and spot buying. Down the road, the strategy is to presort and granulate at collection sites and ship unwashed flake to the recycling plant, reducing labor and handling costs, says Partek's Bitar.

At the start of the recycling line, a bale breaker, built by Hustler Conveyor Co., St. Louis, feeds the bottles up an inclined ramp to a rotating trammel, which removes loose caps and dirt. A magnetized strip catches ferrous metals. Bottles then travel along a horizontal conveyor past two to three people per shift who manually sort out straw

caps, loose labels and unwanted PVC or PET bottles. Electric eyes automatically advance bottles to the granulators at the same pace as the hand-sorting operation. Conveyors were supplied by EMI Plastics Equipment, Jackson Center, Ohio.

The square-flake granulation system begins with a feed hopper and metal detector. Below the hopper, the feed splits to either of two identical small granulators, each capable of 2500 lb/hr. In these low-speed, high-torque granulators, bottles are oriented, flattened (they're already somewhat flat from being baled), and sliced twice, lengthwise and horizontally. The two granulators run in parallel, but allow feed to be diverted entirely to one when the other needs sharpening or other maintenance. The cutting mechanism is on a removable core, so one core comes out and another can be inserted in about 20 min., say engineers who have worked

with the system.

From the granulators, flake is conveyed to an enclosed, very high-shear, cylindrical washing tank. The tank has orbital paddles on one axis and side blades on another axis, so water and surfactant circulate from both directions, says Polk. The wash unit discharges flakes out the bottom through vibrating screeners and a rinse tank, assembled and supplied by Smico Manufacturing Co. of Oklahoma City. Residence time in the washer starts at around 6 min for clean milk-jug flake. Rinsed flake then goes to a hydrocyclone system to separate out "heavies" like PVC, PET, metal and dirt. PP remains with the HDPE, which is transferred to a spin dryer. This plant is one of only a few in the country with water filtering and treatment, supplied by Sweco Inc., Florence, Ky.

Once dry, flakes go to a proprietary continuous batch "refining stage" using



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two kinetic-energy scrubbers to remove labels and glue. The kinetic refiners, which were assembled at Partek, use three internal scrubbing actions. Particles abrade against each other at high speed in complex vortices, knocking off paper particles. The friction also generates heat, which melts and "beads" the glue. For heavily contaminated material, water can also shoot over the mix at intervals. Residence time in the kinetic refiners ranges up to 20 min, depending on the amount of contamination, and is regulated by the computer control system, which senses when the flake is clean.

Dust and fines are removed from the clean flake by either of two aspirators. The latter have five vertical compartments with air blowing crosswise to remove light material as the flakes fall downward. Bins and hoppers are custom made by MAC Equipment Co., Sabetha, Kans. Finished flake is then metered together with additives, into one of two extruders (from HPM Corp., Mt. Gilead, Ohio), with 4.5- and 6-in. diam. barrels and special Phillips-designed screws. The extruders are standard except for a vacuum pump on each that draws off residual moisture and volatiles that cause sour-milk odors. Melt is filtered with a continuous, rotary screenchanger from Gneuss, Inc., Langhorne, Pa. Pellets are made on a Beringer water-ring pelletizer (from Beringer Co., div. of John Brown Inc., Marblehead, Mass.) and go to four 60-ft silos outside the building.

**CLEANS OIL BOTTLES, TOO**

Among its other features, the plant is the only known commercial recycling system in this country that may be able to clean motor-oil bottles. "We're evaluating our system for oil bottles, but have made no decision on whether we'll process them," says Taylor. "It may not be worth the environmental permitting problems."

Partek's Bitar says the plant's recycling technology may be licensed on a nonexclusive basis for a one-time fee of \$1.5-2.5 million, not including equipment, with a small additional fee for added locations. He says it's too early to estimate the cost of turnkey equipment. (CIRCLE 3) □ □

—Jan H. Schut