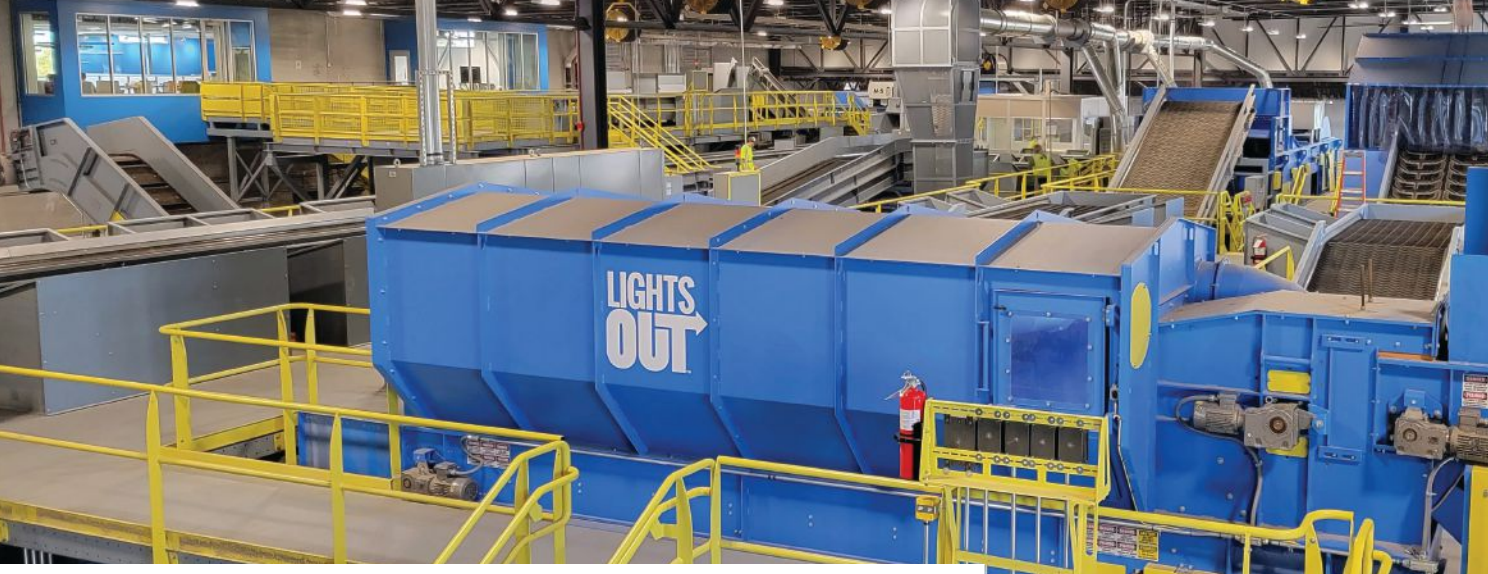



CP Group

# SET FOR Success

## Designing materials recovery facilities for safety and efficiency

BY CAROL BRZOZOWSKI

A well-designed MRF results in increased safety, operational efficiency, a higher-quality end product and therefore better price, reduced maintenance, flexibility to deal with the evolving ton, a better work environment, and expandability, notes Betsy Powers, senior project manager, SCS Engineers.

"The main factors considered when designing a new material recovery facility or retrofit are throughput requirements, material characterizations, commodities to be recovered, building space constraints or limitations, weather, operations such as rolling stock requirements and traffic, and safety," says Ashley Davis, CP Group marketing director.

Key criteria include input—material volume and types—and whether it is single-stream or dual-stream, notes Powers.

Other criteria include market and buyer standards, level of manual versus automated sorting, available space, and budget.

A MRF's initial building phase requires a flow diagram based on the material characterization, throughput requirements, and commodity output goals, says Davis.

"Based on these criteria, a basic flow is put into place with capacities at each machine to ensure there will be no bottlenecks," she adds. "Next, that flow is taken into a 3D modeling program in engineering. Building constraints and operation traffic are considered.

"The traffic, tip floor, bale storage, glass and residue lines, as well as air requirements all need to be considered. Office space, maintenance access, and employee paths should be reviewed and properly planned."

It's important to understand the change in material streams, says Mat Everhart, CEO, STADLER America. "Things are dramatically changing. A lot of advocacy groups have gotten a good foothold in the manufacturing side over the last few years in a way they never really had before.

"As a result, we're seeing a lot of changes in packaging that make a lot of things that weren't recoverable or re-processable into a new product now recoverable."

Todd Whittle, principal, Civil & Environmental Consultants, notes that tons per hour plays a key role in equipment selection.

With no two MRFs being alike, a MRF's market and seasonal composition factor into its design, notes Chris Hawn, Machinex CEO.

Some operations look to recover all commodities clean enough to be marketed as recycling, including various grades of plastics, ferrous, non-ferrous, OCC, wood, and select fiber.

Another example is processing MSW for RDF/SRF applications.

"Sometimes there is a requirement of some commodities prior to preparing the fuel, but the major focus is removing contamination and potentially moisture from the MSW to be classified as a SRF meeting the fuel specifications," says Hawn.

Another example is the operation's market might be for organics extraction for anaerobic digestion, while ignoring the rest.

While such systems can either be tied together in a large campus

or as standalone projects, "what each concept has in common is the need to have a seasonal understanding of the material compositions to understand what you are extracting or purifying at various times of the year," says Hawn.

"Equipment and system selections determine recovery of organics, food, food-soiled paper, and other wastestreams and can increase automation to reduce reliance on labor and improve commodity quality," says Tim Raibley, PE, HDR senior project manager and vice president.

Options for increased throughput capabilities, operations and materials storage requirements, foul odor collection, and treatment are best addressed in early planning phases, he adds.

Ever-changing wastestreams should be a consideration in flexible design components and facility modifications for optimal future operations, Raibley notes.

In addition to how much and when material will be processed throughout the year and what products need to be made according to certain quality specifications, the number of people needed to staff a MRF is crucial, notes Mark A. Neitzey, VAN DYK Recycling Solutions director of sales.

Varying criteria are followed in MRF design depending on community needs.

"Vital components include local and state permitting and building code requirements, equipment recovery and processing rates, and material stream characteristics," says Raibley. "Site constraints must be considered in the facility arrangement."

A facility's location is a key consideration, such as if a state has a bottle bill or not.

"To make high-quality sellable end products, light, flattened single serve containers need to properly separated from the fiber," Neitzey says. "Input streams in a bottle bill state like California might only contain one percent PET bottles and .25 percent UBC in the stream. In a non-bottle bill state like Texas that sees high temperatures, the input stream might have more than five percent PET and over one percent UBC."

Hawn says it's important that a MRF manufacturer gather as much information to understand an operation's specific needs and goals but also understand the contracts in place for receiving the MSW.

After that, "it is important to review and provide similar concepts and budgets to understand if the project even pencils out on pro-forma," Hawn notes.

"After this qualification and a site is chosen, design specific to the operation's goals and markets begins. Together, you evaluate the inbound stream and site preparation. At the end, designs are agreed upon and proposals are completed for the system."

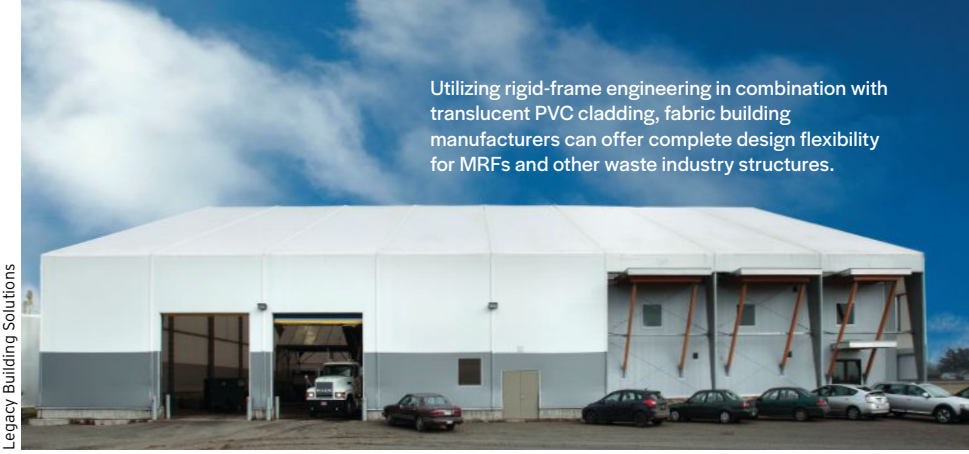
Technology is rapidly driving progress in MRF design, with artificial intelligence playing a greater role. Industry experts note the following:

Size reduction/bag opening to access desired materials at the MSW system front end and enhance the screening process.

Size screening to address different MSW materials in the stream. Various screen types can yield different fractions which may be the desired stream for RDF/SRF, organics, commodity recovery, and others. Each of these sized streams can be handled separately. Screens that don't wrap with material are key. VAN DYK's LUBO non-wrap screens and the Gunther spiral screens maximize system efficiency and uptime while minimizing maintenance and cleaning, says Neitzey. Everhart says STADLER's redesigned rotating screens with anti-wrapping features are another option. CP Group uses the CP Auger Screen directly after the infeed conveyor and prior to any manual sorters, essentially eliminating the presort. "Fractionating the material stream at the beginning of the process creates more homogeneously sized streams, which enhances sorting capabilities downstream," says Davis. "Experience shows it reduces the amount of material on the auger screen post-sort by up to 60 percent. By bypassing that smaller fraction material, fewer manual sorters are needed. These sorters are safer and more productive since the burden depth is largely decreased and needles and sharps are bypassed in the smaller fraction." Davis notes that screens have recently been enhanced to reduce the amount of wrapping while still maintaining a small footprint with high throughput. "These screens liberate fines as well as 2D from 3D material," she notes.

Air density separators. A lot of light fraction can be used in RDF/SRF applications after further sorting, but it can also protect downstream equipment not prepared to handle a very heavy or dense part, Hawn notes. Elliptical separators can properly prepare the container stream for the optical sorters, magnets, and eddy currents by removing the final 2D film and fines.

Newer optical sorters, which encompass AI and robotic technology, offering efficiency and safety. "Once the material stream is fractionated and liberated, optical sorters—the most effective way to sort large amounts of material—are much more efficient," says Davis. "After optical sorters, either manual sorters or robots can quality control the material." Optical sorters target the exact materials to maximize recovery or can protect contaminants and prohibitives from reaching the end product. Increased use of optical sorting equipment across multiple material types such as glass, plastics, and paper and increased screening or ballistic separation (possibly combined with air classification) are other innovations. Optical sorters play a significant role in quality control of containers, removing film from fiber and separating out the OCC outthrows from the fiber. Those that recognize black objects eject them out of the fiber stream. "Think about how many 'to-go' containers are now coming into the home due to COVID and people ordering take-out," says Neitzey. "When those containers are flattened, there is a high probability they end up carrying over screens and wind up in the fiber stream. The ability to see black plastics and eject them from the fiber is a game-changer in the quest to make fiber products with minimal prohibitives."



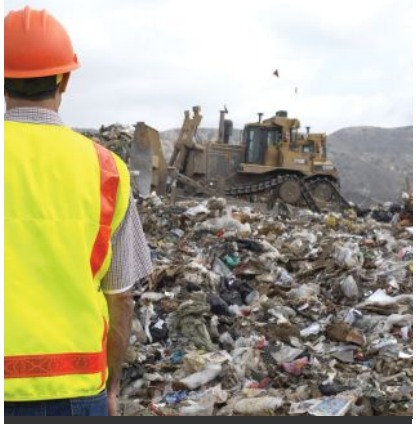
Utilizing rigid-frame engineering in combination with translucent PVC cladding, fabric building manufacturers can offer complete design flexibility for MRFs and other waste industry structures.

Legacy Building Solutions

Robotics/vision systems as a quality control method or a way to analyze the stream at a certain point in the process. Robots help reduce manual labor reliance, provide another chance to pull commodities from the residuals line, and can produce cleaner bales by removing contamination along QC lines, notes Powers. Vision systems with neural networks can help MRFs gather real-time metrics on inbound material and contamination data, as well as at key points throughout the processing system, she says, adding operators can use this information to adjust equipment and to make capital expenditure decisions.

Flat/round separation equipment. "Whether using ballistics or disc screens, the decision could be to take all of the flat fraction as the desired product, leaving the rounds as residue or you could consider recovering commodities from the rounds," says Hawn.

Fine shredding. "This is a final step in some requirements and requires a rather homogeneous stream without heavy metal parts or stones," says Hawn. "This fine shredding can often be followed by some form of densification for transportation needs."



Cardboard recovery technology, which augments current options, leading to even distribution systemwide, notes Everhart. "Then focus on technologies available now that don't have you losing too much of your material as a contaminant right off the bat," he adds.

Fire Rover, which consists of an onsite system that uses sensors to detect heat, says Powers. A remotely operated central system will trigger the onsite system to spray fire protection foam on hot spots or fires.

"Constructing a material recovery facility (MRF) in an optimal fashion can save hundreds of thousands of dollars on a project versus an overbuilt structure," notes Matt VanScoyoc, Legacy Building Solutions, design consulting representative.

"Using the proven engineering of structural steel framing, fabric buildings can achieve long clear spans and tall clearances for equipment and vehicles, particularly when tipping and dumping," says VanScoyoc.

Sidewall doors can be precisely positioned for trucks to enter and leave, he adds.

"Most importantly, architects can work with the fabric building manufacturer to calculate customized elevation points for the building frame and columns—a necessity when accounting for below-grade drive-through pits and other unique MRF features."

VanScoyoc notes fabric building solutions bring other inherent advantages, such as cost-effectiveness, speed of installation, and translucent roof cladding material allowing natural light to illuminate the building interior during daylight hours and provide comfortable interior conditions.

"Rigid-frame fabric buildings also make it possible to incorporate conventional methods and materials, making it easy to insulate portions of the facility such as for an office buildout without wasting money to needlessly insulate and climate control the entire building," he adds.

Safety is paramount. A single point of lock-out, tag-out is critical to perform maintenance safely on equipment, notes Powers.

"Safety mechanisms such as e-stops and pull cords allow your MRF staff to shut the system down in case of emergency or identification of certain materials in the system," she adds.

Staff also should be trained to deal with various materials that may be encountered, such as sharps and lithium-ion batteries, notes Powers.

A fire suppression system is important to dealing with the more common fires occurring at waste-handling facilities.

More standard industrial safety mechanisms such as incorporating cameras at blind corners; cleaning up areas to reduce slips, trips and falls; safety railings along stairs and platforms; dust control, and general safety working around moving equipment also is critical, notes Powers.

Anything that can be done to limit touch points for employees is critical, notes Whittle.

With staff shortages broadly affecting municipalities, it's critical to establish work conditions that attract and maintain reliable staff, says Raibley.

"Integrating mechanical, optical, or related systems to reduce reliance on labor is a smart move," he adds. "These more sophisticated technologies raise the need for maintenance and training at the modern MRF. Flexible design is a must-have for any new MRF. As feedstock varies into the future, adaptability is key in enabling the MRF to maintain efficiency."

Non-wrapping screens and spiral style screens are evolving to make the presort—the area with highest concentration of labor—to be more safe, says Neitzey.

"It minimizes fines and hazardous materials to have to 'swim' through in order to properly sort the non-recyclables out of the stream," he adds.

Elliptical separators and optical sorters with slide-in platforms also provide for safer operations.

"The design of accelerator belts in the optical hood enclosures around the safety focus has been a huge deal in the last few years," says Everhart, adding that previous designs required servicing in significantly confined space.

Today's designs offer drawbridges or gantries that fold down enabling those servicing the units to do so in a well-lit space and from a comfortable position.

"ANSI's been a big part of that," Everhart says. "OSHA has always revised their requirements but in general I think it's the manufacturers themselves who realized by listening to their customers just how difficult it was to service these machines in the past.

"All optical suppliers have made a major effort over the last four years to revise the mechanical designs of their optical units so that you can get in there and search for something more safely and quickly."

A well-designed MRF benefits from increased materials recovery performance, better odor control, improved environmental impact, less reliance on labor, and potential revenue increases, Raibley says.

"The biggest driver hurting recovery in the last decade is people running more material through their MRF on a per-hour basis than what it was designed to do," says Everhart. "The system is down more than they projected. Focusing on a smart design lead for a particular product stream with good maintenance access leads to more uptime.

"You can make up a lot of tons per hour and run more hours. The average company two years ago was running 80 to 85 percent average uptime hours. A lot of facilities are running 90 to 95 percent."

That extra time means the ability to run more material, Everhart says, adding, "the biggest thing is just focusing on a system that's got the right technology for your specific product stream but then focusing on a system designed for maximum uptime and serviceability in mind." MSW

*Carol Brzozowski specializes in topics related to resource management and technology.*