THE ROAD TO BETTER PRODUCTION, ACCURACY AND RELIABILITY

AI AND OPTICAL SCANNERS, ENGINEERED FUEL AND 3-D MODELLING – KEY CONSIDERATIONS WHEN PLANNING FOR SUCCESS AT THE MRF

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An experienced consultant can assess operational and energy efficiency and help operators select upgraded equipment, improve performance and reduce costs.

Material recovery facilities (MRFs) are seeing many challenges that directly impact operations. Some of these challenges include: new recycled material quality standards from China, the ratcheting up of voluntary and mandatory local and state recycling goals, lower tolerance for worker injury, increasing volumes and a changing waste stream, disposal bans on organics in landfills, and high demand from emerging energy markets for organics.

This article will provide an overview of the latest developments in MRF processing equipment systems that are helping owners and operators meet these challenges and at the same time helping maintain a healthy bottom line.

Understanding these new technologies is important when planning and designing either a rehabilitation of an existing MRF or the development of a new one.

OPTICAL SCANNING

One of the biggest technology breakthroughs in recent years has been in optical scanning technology. Optical scanning merges specific algorithms (computer programs) with precision scanning optics and cameras, as well as computerized air jets. In milliseconds, these air jets respond to computer commands by sending precise, directed blasts of air, separating desired materials from other materials. Accuracy with optical scanners is very high – typically well over 90 percent. (A generic diagram of an optical scanner is shown in Figure 1.)

This technology allows any downstream separation process to be more effective in further separating valuable materials. Optical sorting is available to sort glass by colour, plastics by resin and shape, wet paper from dry paper, soiled paper from clean paper, lumber/wood from other materials, ferrous and nonferrous metals, and certain parts of electronic scrap (e-scrap).

Another reason optical scanning is gaining in popularity is that the typical municipal waste stream is changing. The waste stream is seeing more plastic bottles and more cardboard, both of which are lighter than they were years ago. This can be attributed to the so-called "Amazon effect," which can be defined as "the impact the digital marketplace has on the traditional business model regarding consumer expectations and the competitive landscape."

The result of more plastic bottles and cardboard is that the waste stream is "light-weighted" (a term coined by the industry) meaning it takes more of the same material to make a ton than previously. The result is that the recycling facility has to process a larger volume of material. This is where the use of optical scanners becomes the most advantageous.

Payback on an optical scanner performing separation of HDPE plastics is within a year, at a throughput as low as 500 pounds per day. A human cannot compete with the accuracy, safety, reliability and consistency of these machines. However, in some situations, workers are needed to do an initial removal of overburden so that the scanner can perform at its highest efficiency.

THE FUTURE IS NOW

The next level of automated sorting may be machines that are equipped with artificial intelligence (AI). Several companies have been experimenting for the past 10 years or so with the technology and have produced various experimental prototypes for recycling activities.

One type of AI, image recognition, provides a machine with the capability to "learn" in a manner that more closely resembles how a human might learn how to visually recognize a person's face.

For example, your friend Joe has bushy eyebrows. You remember this association and it is what tells you that it is Joe that you are talking to when you see the bushy eyebrows. In a similar, but less complex way, an AI machine has the ability, with sophisticated cameras and high speed computers, to visually break down an object into very small pieces called pixels. These pixels are analyzed through the machine's extensive network of decision-making formulas, allowing it to see a sharp image, from which it learns what materials to select and what to ignore. All of this happens in milliseconds, so that the 'decision' is relayed to extend the arm to pick the desired material.

Current optical scanners use a simpler form of image recognition that is limited to a specific set of data and information. If the material does not fit this set of decisions it is ignored. The AI machine can identify multiple materials and make

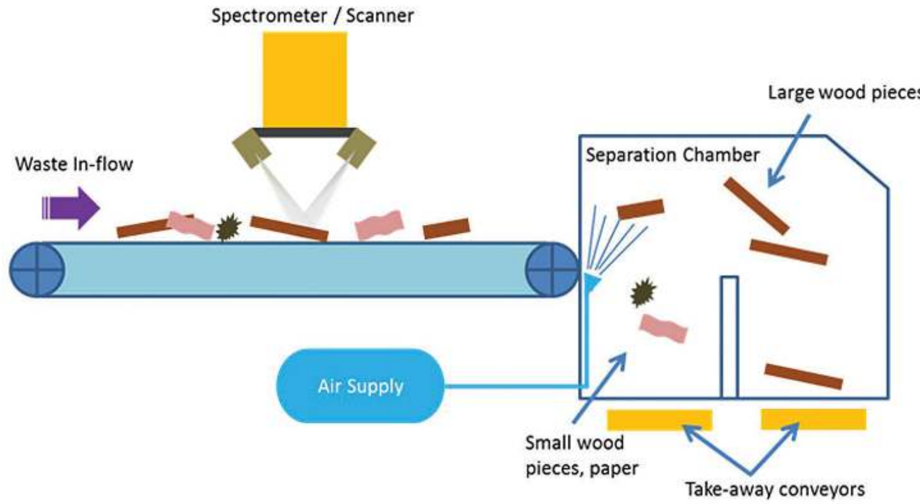

Figure 1. Generic layout of an optical scanning machine.

split-second decisions on all of them.

This extra capability is expected to provide MRFs improved performance in recovering many desirable materials that are currently missed by manual selection and optical scanners. AI-equipped waste and recyclables sorting machines are being offered by AMP Robotics and Bulk Handling Systems, among others.

AN INTEGRATED APPROACH

Another welcome change in the MRF landscape has been the emergence of companies that can select components and assemble them into a complete system that meets the specific needs of the customer.

These companies then manufacture or procure all the required equipment, and take responsibility for meeting the system performance goals. This one-stop, integrated approach simplifies responsibility for making sure, at startup, that the system is synchronized and any adjustments are made so that all parts are working seamlessly. Another benefit to the user is that most of these companies have automated controls that are tailored to the system and to the end user. There are almost a dozen companies, from Canada, the U.S. and Europe, that can offer complete, integrated systems tailored to a wide variety of waste sources and specific end markets and uses.

While new, from-the-ground-up facilities are great, many older MRFs can also be retrofitted, where specific pieces of equipment are added or a manual task is replaced to take advantage of automated sorting performance.

Experienced consultants can help in these situations. A consultant can assess operational and energy efficiency and help operators select upgraded equipment, improve performance and reduce costs. Consultants can also interface with equipment providers, many of which have full-scale test facilities, and can test waste samples before deciding on equipment to ensure that the right separation technology is employed.

ORGANICS PROCESSING ON THE RISE

The diversification and specialization of waste sorting systems has paralleled the growing interest in use of waste organics for producing energy. High energy use industries have been creating a demand for so-called "engineered fuels." Engineered fuels are derived from solid wastes and have been extensively processed to remove most contaminants and reduce moisture content in order to maximize thermal value (specified in British thermal units – BTU, or higher heating value – HHV).

Now, instead of landfilling yard wastes and food scraps, some of these materials are being processed through sophisticated sorting systems, becoming a source of revenue instead of a disposal cost.

Customers can choose from conventional trommel separators or disc screens for the initial extraction/separation of organics from other wastes. The organics can then be processed and further cleaned of contaminants by the use of optical scanners, to extract unwanted bits of plastic, glass, grit and wood pieces. Then the organics are ready for final sizing, drying and pelletizing (if desired) to produce the engineered fuel.

BHS' Max AI technology uses "deep learning" technology, to identify recyclables similar to the way a human being would.

Top: AMP Robtics' artificially intelligent Cortex system uses optical scanning to distinguish between plastics, cartons and fibre based on various characteristics.

3-D MODELLING

Other technologies that are being used to reduce design time and errors in design of MRFs are computerized software that provide a detailed, three dimensional (3-D) scaled rendering of a MRF system. These detailed drawings allow the designer to integrate the mechanical, electrical, ventilation, structural and processing systems inside the building and assess clearances for installation, operation and maintenance. It also allows designers to rapidly assemble a list of components for cost estimating, or produce any number of different views for use in preparation of the construction plans. 3-D renderings also allows the entire system to be clearly visualized, which can help with determining location of viewing stations for checking on system operations, and even routine items such as the most efficient routing of power conduits.

MRFs equipped with the latest technologies are able to meet tightening standards for traditional quality recycled materials and some are also starting to provide a separate, clean organics stream for downstream alternative energy projects. Many MRF operators are now benefitting from these new technologies, with increased throughput and quality of end product.

Consideration of the latest technologies is a key element when planning and designing an MRF.

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