MATICS

Use Case

Waste Management: the Benefits, Challenges, and Implementation of Internal Recycling in Manufacturing Operations

Executive Summary

Internal recycling is an attractive prospect for manufacturing operations across many different industries. The practice can often provide significant cost savings, particularly in industries dealing with metals, plastics, and other relatively easy-to-handle materials. Manufacturers can also enjoy a positive public perception of their efforts, or at least avoid negative perception due to poor waste management.

These benefits come with accompanying challenges. In almost every case, additional equipment is required, along with its operational and maintenance costs. Not all materials used in manufacturing allow for practical use as recycled feedstock. The use of internally recycled feedstocks can cause quality issues and is often not readily accepted by production teams.

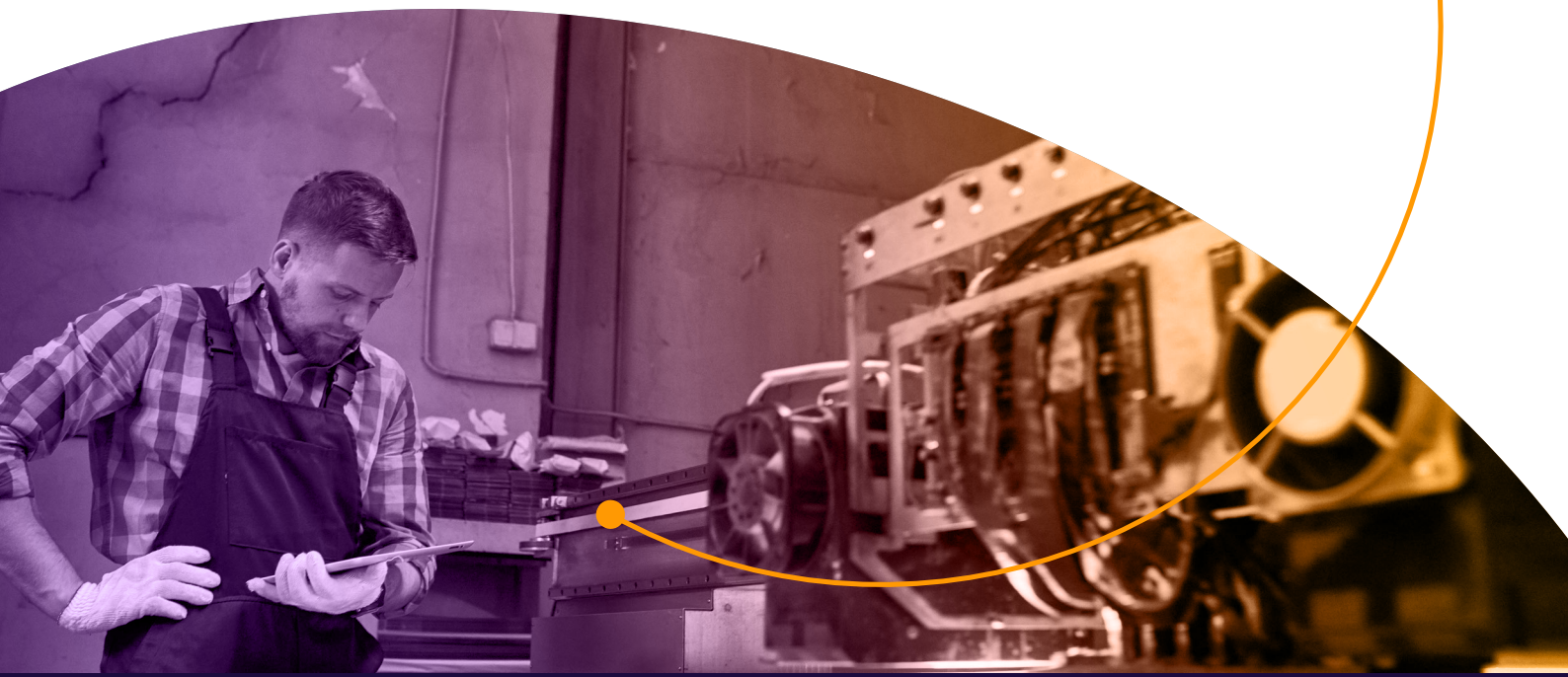
Manufacturers can overcome these challenges through the development of quality and recycling policies that mitigate waste and generate value. The proper implementation of the quality and recycling policies requires access to meaningful, real-time data on KPIs and other production parameters. Matics provides a solution for manufacturers that lets them successfully implement, control, and monitor these policies.

Background

There has never been a greater focus on recycling than there is today. It's being implemented just about wherever possible at every level around the world, with individuals, governments, and manufacturers all playing a significant part.

Most people are already familiar with external recycling, where manufactured goods are collected at the end of their useful life and recycled instead of going to landfills. It's a massive industry, expected to reach a size of nearly $85 billion globally by 2028 (Polaris Market Research, 2021). However, there's another integral component to modern recycling efforts.

Internal recycling takes place within the manufacturing environment. It focuses on the transformation of defective units or parts back into a useable feedstock. Methods and extent vary widely across different industries, with some examples like plastics and metals manufacturing being better suited for direct internal recycling.



The Cost Benefits of Internal Recycling Efforts

Until recently, cost savings have been the only major driving force in internal recycling. In manufacturing environments producing metal parts, it has been a long-established practice. Shavings, scraps, defective units, and other sources of metal are collected and simply melted down alongside fresh materials to go through the process again.

The value of the defective materials is essentially the same as that of the virgin raw materials. Recycling them is the only sensible economic move to make. While this is evident for metal casting, the cost benefits of internal recycling in other industries can require more insight to uncover.

In plastics manufacturing, for example, defective units must be put through a grinder to be made into a suitable feedstock. Even this addition of one single step complicates the matter, leaving the manufacturer to weigh the cost of wasted material against the cost of purchasing, operating, and maintaining additional process equipment. In this example, the savings do outweigh the costs, but there would be more to consider even if they didn't.

The Public Perception of Recycling

The second major factor for manufacturers to consider is the public perception of their recycling efforts. In the United States, consumers place much of the responsibility for reducing plastic waste on manufacturers and expect them to take action (World Wildlife Fund, 2020).

This trend can be clearly identified by the practice of many organizations to list the percentage of recycled material prominently on their products, notably among beverage companies. While this practice in particular largely revolves around external recycling, internal recycling can be just as important to a manufacturer's reputation.

In many manufacturing environments, internal recycling is required to avoid negative public responses. It's not seen as an additional benefit but rather as a requirement by the public. Excessive amounts of any material, and particularly plastics, being sent to landfills is a bad look for the manufacturer.

Case Evaluation

It's clear that the cost reduction and public perception benefits make internal recycling an effective choice to implement wherever possible. However, there are many additional challenges that manufacturers must address to develop, implement, and run their internal recycling programs.

Additional Process Steps

Using externally recycled feedstocks for any product requires careful insight into whether or not the quality and composition of that feedstock is suitable. Internal recycling requires both an assessment of the recycled feedstock's quality and the development of the process to reach that quality consistently.

In the case of plastics recycling, this typically refers to size reduction. Any completed unit, defective or not, is unlikely to be suitable for immediate reprocessing. Instead, it must be ground to the appropriate size to serve as a feedstock for extrusion, molding, or forming. This allows for a uniform composition and is the same reason virgin plastic feedstocks come as pellets or flakes.

While adding more equipment to the factory floor is something to consider, it is almost surely cost-effective. Any manufacturer would carry out a cost-benefit analysis to be sure, but consider for a moment that external plastic recycling operations manage to turn a profit not just grinding but also having to deal with the collection, sorting, cleaning, and further separation (Hopewell, Dvorak, & Kosior, 2009)

Integration Into Existing Process

Plastics manufacturing relies on primary recycling or closed-loop recycling for internal recycling programs. This is the simple mechanical recycling of materials into the same product. However, this isn't possible for all industries or even all types of plastics.

Many industries cannot implement a simple internal recycling program. Instead, they must find solutions elsewhere for mitigating waste. This can take the form of a downgrading, where a defective product finds another use that recovers some but not all of its value. Others, particularly agriculture, manage waste through energy recovery, burning, or otherwise recovering useful energy from waste materials.

In plastics manufacturing, common materials that are suitable for direct internal recycling are generally thermoplastics like PET, PET, and PP that can be easily re-melted and re-formed (Hopewell, Dvorak, & Kosior, 2009). Of course, there are other factors at play as well.

Avoiding Defects

Any manufacturing environment contends with defects and defective units, which is why they need internal recycling in the first place. There are many different types of defects that can lead to a plastic unit being found unsuitable for use, including warpage, delamination, discoloring, cracking, bubbles, and blistering.

While these issues can have a variety of causes, raw material quality is important. In most applications, a mixture of both virgin raw materials and recycled materials must be used to ensure that quality criteria are met. When the proportion of recycled materials is too high, additional defects can start to occur.

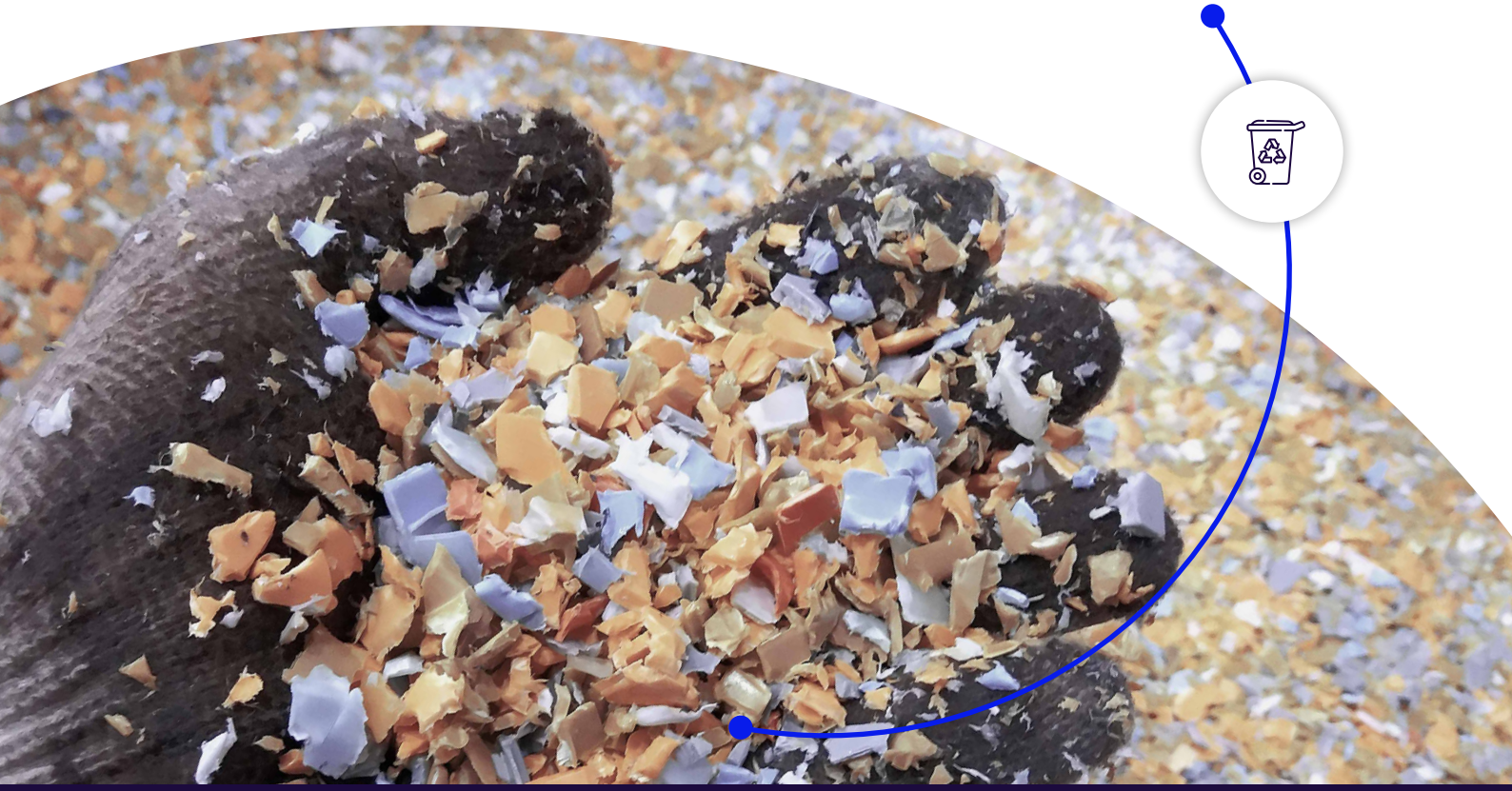
This is particularly notable in the extrusion of recycled thermoplastics. When a high enough percentage of mechanically recycled materials is present, both the tensile and impact strength of the final product can be negatively affected (Schyns & Shaver, 2020). The defect rate will set a firm limit on how much recycled material can be used.

Production Team Adoption

It's relatively easy to put down on paper the idea that a manufacturing environment should implement internal recycling. However, putting the idea into action requires the participation of individuals at every level of the organization, including the production team.

Production teams can often be reluctant to make use of internally recycled feedstocks. Any change to a process can cause serious problems for supervisors and crew alike, and in the case of internal recycling, they're introducing a variable that is known to bring unique challenges to the manufacturing environment.

In both extrusion and molding processes, including recycled feedstock introduces variability that the production crew must account for. This means more fine-tuning and adjustments, especially when dealing with variable proportions of recycled materials.



Proposed Solutions

Manufacturers know that there are benefits to internal recycling, and they know that there will be challenges. Now, they need to develop a solution that will allow them to navigate those challenges effectively.

In most manufacturing environments, this will require a two-pronged approach. It's not enough to establish a recycling program to address waste. Manufacturers must also implement effective policies for reducing the amount of waste produced.

Developing an Effective Quality Policy

Any kind of production environment needs a quality policy as part of its quality management system. There are many guidelines out there for developing an effective quality policy, including ISO standards and elements of process improvement systems like Six Sigma and Lean.

The practical application of the quality policy is going to focus on defects. The quality policy will define the acceptable rate of defective unit production. If that rate is exceeded, then corrective action must be taken by the production team, management, or both. A good quality policy will include both short-term and long-term quality targets.

Quality policies are highly technical and specific to the manufacturing environment in question. Plastic manufacturers can find many effective resources for developing their quality policy in ISO 25337:2010, a standard for statistical quality control, although every process will have many factors affecting what their acceptable defect rate is.

Developing a Practical Internal Recycling Policy

With the quality policy in place, there is still the question of how to handle defective units. The recycling policy will define how defective units are to be recycled and how the recycled feedstock will be reintegrated into the production process.

Among the most important elements of the recycling policy will be the appropriate ratio of recycled material to be used in production. For many plastics, defects in manufacturing increase with the amount of recycled feedstock in the recipe (Schyns & Shaver, 2020). Because the quality policy has been set to allow only so many defects, this puts a limit on the amount of recycled material that can be used.

Just as important is the lower limit established by the recycling policy. This plays an essential role in ensuring that the production team is making use of the recycled feedstocks. Manufacturers will have to consider what the expected inflow of recycled material will be based on the production of defective units and scrap. The recycling policy should optimize use to ensure that all available recycled materials are being used.

Implementation

The quality and recycling policies are essential for making use of the potential cost savings and public perception benefits that come with recycling. How these policies are implemented and enacted will decide how successful a manufacturer's efforts will be. Matics provides a comprehensive Real-time Operational Intelligence (RtOI) solution that addresses these challenges at every level.

Real-time Management

In order to know that the quality policy is being followed, management must have reliable access to real-time information from every stage of production. The Matics solution aggregates data from all machines within the production environment, along with any existing ERP or MES system. Managers and supervisors will be able to view KPIs and additional information for individual machines, departments, or the entire factory.

Smart alerts let manufacturing teams know when the defect rate or other indicators aren't meeting quality policy standards. The solution provides this data to the appropriate individuals with the appropriate context and format to take action quickly and make the right decision based on meaningful and accurate data.

Recipe Management

When implementing a recycling policy, recipe management can quickly become a challenging task for production teams. The introduction of additional variables into recipe management could lead to recipes being put into production that don't meet process requirements and lead to more defects.

Matics' recipe management provides an integrated tool for recipe storage and analytics. This makes it significantly easier for production teams to manage material flows, ensuring better adherence to both the quality and recycling policies.

Dosing System Integration

The Matics solution can integrate directly with production machines, including the dosing system. This dosing system helps prevent mistakes and simplifies downloading recipes into dosing system controllers. This can greatly reduce the chance of human error in cases where introducing recycled feedstocks requires regular recipe adjustments.

An integrated dosing system also provides actionable data for production teams. When integrated into the Matics system, the dosing system can provide alerts to the right people at the right time, allowing timely corrections to be made and the quality policy to be maintained.

Comparing Targets and Actual Performance

The Matics solution aggregates data from the production environment and provides it to management and production teams in a way that is understandable, actionable, and customizable. With both real-time and long-term data available, manufacturers can easily compare the targets set by the quality and recycling policies with the actual performance on the factory floor.

This ability to implement oversight and accountability into the quality and recycling policies is key to their successful implementation. With the wealth of meaningful and contextualized data that the Matics solution can provide, manufacturers can enjoy the benefits of a successful internal recycling program.

Conclusion

Many industries have the need for some kind of internal recycling program. Whether it's the direct recycling of materials like metals or plastics or some more complicated scheme, having the ability to effectively oversee and manage the program is going to play a key role in its success.

With not only the direct cost savings of recycling material but the public perception issue to consider as well, most manufacturers can't afford to overlook recycling. With the challenges that it brings in terms of implementation, integration, quality, and adoption, most manufacturers aren't currently equipped to get the most out of their internal recycling program.

Matics is supplying these manufacturers with the solution they need to find success in the internal recycling programs. With real-time and historical data aggregated from the production environment, Matics lets manufacturers realize and optimize the benefits that come with successful internal recycling.

References

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