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CENTER FOR SUSTAINABLE SYSTEMS

CSS Case Studies: Pulp and Paper

Intern Case Studies
By Jeremy Hoeh, CSS/MDEQ Intern, Summer 1998

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Pulp and Paper Industry
Case Studies Project

These case studies were made possible by support from the Michigan Department of Environmental Quality's Pulp and Paper Pollution Prevention Program, or P5, a voluntary environmental initiative open to all pulp and paper companies in Michigan.

The objectives of the program were developed by a partnership between the Michigan Department of Environmental Quality (MDEQ) and the Michigan Pulp and Paper Environmental Council (MPPEC). Through the P5, the Pulp and Paper industry is working together as a sector to achieve less environmental impact.

Participants in the P5 identify environmental substances of concern and establish priorities and goals for the reduction of their use, generation, discharge, or emission. The basis for determining which activities to pursue includes environmental impact and economic and technical practicality. Technology transfer shared through the experiences of the participants is an integral part of this program.

The following report is a product of technology transfer. The report consists of four case studies illustrating a small number of all the pollution prevention projects taking place at P5 mills. These four case studies were accomplished through the Center for Sustainable Systems' 1998 internship program. This non-proprietary technology transfer is achieved by developing such case studies and also through education and outreach activities.

CSS Case Study:
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Biosolids Composting

By Jeremy Hoeh, MDEQ/CSS Intern

Company Background

Menasha Corporation is comprised of over 60 facilities that manufacture products and offer services ranging from corrugated containers, printed products, and food service items to consumer product labels, plastic components, and returnable material handling systems. Headquartered in Neenah, Wisconsin, Menasha celebrates its 150-year anniversary in 1999 and is one of the oldest privately held manufacturing companies in the United States.

The Paperboard Division of Menasha Corporation employs approximately 220 people full-time. The pulp and board mill produces 800 tons of corrugated medium (paperboard) daily, which is used to make corrugated containers (boxes) both internally at Menasha's packaging plants as well as state converters. Corrugated paperboard is produced from renewable resources ranging from a balanced combination of virgin wood fiber and recycled corrugated containers to 100 percent recycled content. The Paperboard Division's Forest Management Program also is committed to the stewardship of southwestern Michigan forests and the Michigan Sustainable Forestry Initiative. Menasha's foresters can assist forest landowners with making informed decision to improve their woodlots.

Composting Process

In papermaking, water is used to dilute pulp to a fine slurry of wood fiber. This slurry is then pressed and dried into paper. Along the way, many materials get picked up by the large amounts of water passing through the mill. Also, organics from the pulp are extracted and diluted with the water. This process water must be treated to remove these substances before being returned to its source and reused.

Usually, the first stage in the treatment of wastewater is to remove as much of the solid matter present as possible. In the case of a paper mill, these solids are mostly composed of organic materials: cellulose, hemicellulose, and lignin from the wood. The rest of the solids composition can be ash and nutrients like nitrogen and phosphorus or inorganic particles such as clay, calcium carbonate, and titanium dioxide. Some residue of bacteria used for secondary (biological) treatment may also be present. The solids are commonly referred to as "sludge"; specifically, the solids from secondary treatment are sometimes termed "biosolids."

The sludge can contain materials that promote plant growth and have a natural resistance to disease. Instead of landfilling this waste product, Menasha Corporation of Otsego seeks useful alternatives. Because Menasha manufactures corrugated medium, the amount of inorganic substances in its sludge is lower than that of mills producing coated or printing paper.

Since 1974, Menasha has land-applied biosolids in slurry form to local farmland. As the mill began to expand and increase production, the amount of sludge produced also increased. Screens and filters do reduce the amount of fiber lost in the process, but the mill has still had to hunt for more farmland acreage. At the same time, some of the farm sites used in the past were being developed into residential areas. The mill was forced to look for available farmland further and further from the mill. This added distance increased the cost of delivery and lessened the frequency and amounts being applied. The mill began to look to alternative methods of using the biosolids.

Menasha began dewatering the sludge with belt filter presses, making for a more versatile and easily transportable product. The mill considered composting the dewatered sludge. With a composting company, it discussed the feasibility of creating a product from the waste and wood fines from the mill's chipping area. Following a series of trials of making compost and topsoil materials in 1995, the company started to manufacture the products at a location on the mill site

that same year. Menasha formed a partnership with Renewed Earth, a supplier of topsoil and container mixes for the landscape and nursery industry.

Renewed Earth manages the research, manufacture and marketing of the compost project. Menasha has benefited economically through land application cost savings and the added income from the sold product. Renewed Earth sells the high quality compost products in the Greater Kalamazoo, Battle Creek, and Grand Rapids areas of Michigan.

Menasha's objective is to use 100 percent of the biosolids produced at the mill for the composting project and similar beneficial uses. Currently, the mill produces 11,000-12,000 dry tons of biosolids per year. Menasha still continues to land-apply the sludge not used for composting.

In 1996, the partnership produced 35,000 cubic yards of container mix compost. This mix is suited for nurseries that grow potted perennials and bushes.

In addition, 10,000 cubic yards of topsoil material were also produced. This material received approval to be used by the Michigan Department of Transportation for highway construction and improvement projects. The users of the products have been very pleased with the quality: the material is lighter than soil, making for easier application; it doesn't clump when wet; it is practically weed-free; and it promotes plant growth due to the presence of the organic substances.

The compost is not entirely made up of biosolids — different mixes may contain composted leaves, hardwood bark, pine bark, and long grain rice hulls. Temperatures, moisture measurements, pile turning, and test results are all recorded and entered into a computer.

Menasha has encountered a few barriers in developing this project. For one, compost takes time to make: the pile of organic material has to heat up and stay at certain temperatures in order to degrade into a useful product. While this process is taking place, the huge piles of compost are taking up space. The Menasha mill has limited land available for the composting project.

Another problem is finding customers — because the composted soil product is relatively new, landscaping and nursery companies may be skeptical at first. This problem is decreasing as the product proves its worth.

The market area is also a concern. The costs of shipping are high; therefore, selling to the local area is the only way to remain competitive. However, sales are projected to increase dramatically within the next coming years.

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Flyash Recycling

By Jeremy Hoeh, MDEQ/CSS Intern

Industrial sites, such as paper mills, require large amounts of electrical power. Many paper mills have their own power plants to help meet their massive energy requirements. Some of these onsite plants can generate enough energy to power the whole mill; others must purchase some energy from local plants to meet their needs.

One way of creating energy is by burning coal in a boiler system to heat water and produce steam. The steam is used to turn turbines connected to a generator to produce electricity. It can also be used for space heating in the winter and for drying within the production process. Other material, such as waste biosolids and waste wood products, can also be burned for energy. When anything is burned for heat energy, it also gives off byproduct gasses and a solid residue called ash.

Flyash is a type of ash derived specifically from the combustion of coal. This finely divided residue is transported from the firebox through the boiler by flue gases. The ash can be landfilled or used to make new products. Reusing waste products is a good method of pollution prevention. It not only saves landfill space but also can be an economical benefit to a company.

ABTco, Inc.

The ABTco mill in Alpena, built by Abitibi, began operation in 1957. It produces 400 tons of two-sided hardboard each day. This hardboard is finished into panelling and other wall coverings. The mill employs 265 people full-time. The ABTco powerhouse generates around seven megawatts of power, about half of the amount needed to operate the mill. The remainder is purchased from the local Alpena power plant.

ABTco's powerhouse contains two coal-fired boilers and one fired by biosolids and reject wood particles. All three boilers burn natural gas to help complete combustion and reduce emissions. The natural gas allows for a more efficient and regulated burn. Each year, ABTco burns approximately 40,000 tons of coal and produces about 12,000 cubic yards of flyash. One hundred percent of the flyash created is trucked to a brick manufacturer in the Detroit area. The flyash is then used as a filler material in the making of bricks. Annually, ABTco saves $35,000 to $40,000 over landfilling the ash. According to ABTco Environmental Engineer Mike Connell, "With the steady decrease in landfill space and the corresponding increase in tipping fees, nothing should be landfilled when it can serve another use, such as a raw material."

ABTco started looking for alternatives to landfilling the ash after Alpena County signed a partnership with a local landfill. This would require that all ash be sent to the same landfill, no matter what the cost. In searching for cheaper ways of disposal, the mill found a brick manufacturer looking for cheaper raw materials. This was a perfect match. Once ABTco found a trucking firm to deliver the ash, the project was underway.

Emptying the boiler ash, a 90-minute process, is performed once during each of the three shifts. Vacuum lines move the ash to a silo, where the ash is wetted for easier handling and moved into piles; these are loaded into 40-cubic-yard trucks. ABTco pays the shipping fee.

Georgia-Pacific Corporation

Georgia-Pacific's Kalamazoo Business Unit also recycles its ash. The original Kalamazoo mill was built in 1867 and became part of the Georgia-Pacific family in 1968. It produces 400 tons of coated and uncoated fine printing papers daily from recycled materials (60 percent recycled, half of which is post-consumer). The recycled materials are derived from the de-inking facility onsite. The mill employs 290 people full-time.

This mill recycles both flyash and bottom ash, with flyash composing of more than 90 percent of the volume. The mill generates most of its own power by burning coal and natural gas. The power boiler creates approximately 15,000 tons of ash each year. The ash is

recycled into cement and cement products at one of four approved cement kilns. Each of the cement kilns has passed an environmental review.

The project met some obstacles in its inception. First, the quality of the ash needed to meet raw material specifications at the cement kiln. Therefore, the ash is tested to see that it is within specification and contains no potential contaminants. The ash does contain silica and small amounts of metals. (Some metals can affect the strength and drying qualities of the cement, but the Georgia-Pacific ash doesn't contain such metals.) This information is shared with the recycling contractor.

Second, the project needed to be economical. Landfilling fees in southwest Michigan have been low the past several years, and the recycling contractor had to take this into account. It does cost less to recycle Georgia-Pacific's ash than to commercially landfill it.

Third, the regularity of service needed to be considered. The coal is being burned constantly at the mill and the ability to store the created ash is limited. The transportation vendor has had to insure regular service in order to keep a continuous operation intact at the mill.

There have been no regulatory or permitting issues affecting the recycling process.

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Wastewater Aeration Membranes

By Jeremy Hoeh, MDEQ/CSS Intern

Company Background

Smurfit-Stone Container started as a sulfur pulp mill in 1921 under the name of Northern Fiber Co. and went through many changes. The mill is currently owned by Smurfit-Stone Container Corporation and now employs 277 people. The mill produces 815 tons of brown corrugating medium daily.

The Papermaking Process

Water is essential in papermaking. It is the carrier for the fiber that is put onto the paper machines. This slurry, called paper machine stock, is 99 percent water and one percent fiber. Water is used to dilute pulp to a fine slurry of wood fiber which is then pressed and dried into paper.

Organics from the wood pulp are extracted with the process water. This process water is treated to remove organics before it is returned to the envrionment.

After removing most of the primary solids in the water, the mill focuses its' control on BOD (biochemical oxygen demand). Basically, BOD is a parameter that measures the tendency of effluent to consume the dissolved oxygen of its receiving waters. This consumption takes place due to natural biological processes: microorganisms present in the water devour organic materials.

BOD must be reduced to enable living things in rivers and lakes to get essential oxygen to survive. Nature's way is to let the water absorb oxygen from the air, which is a very slow method and easily depleted. Supplying enough oxygen to the water in an enclosed area is the treatment technique used for BOD removal at the Smurfit-Stone mill. One method is called a waste-activated sludge system.

The BOD removal at the Smurfit-Stone Container Corporation mill is accomplished by passing large quantities of air through the wastewater in large aeration basins. This aeration is accomplished with mechanical blowers and many thousand fine bubble diffusors. Using fine bubbles creates more surface area contact, better transfer of oxygen to the water, and quicker removal of BOD. Smurfit-Stone Container Corporation of Ontonagon, MI examined their current process to make it more efficient.

Improvements to Process

The Smurfit-Stone Container mill owns and operates a wastewater treatment plant onsite and processes about four million gallons of water per day. The team at Smurfit-Stone wanted to operate a more efficient wastewater treatment plant while decreasing costs. The aerator disks in use at the time were made of ceramic and became a point of focus. The ceramic disks became fouled by an iron-producing bacteria which reduced efficiency and required cleaning twice a year. With two aeration basins containing 11,520 of the 8.7-inch diameter disks, this was a time-consuming process. Also, by shutting down the mill twice each year, earnings were reduced. Money was lost from start-up and shut-down losses, cleaning costs, and lowered production levels during the outages. The mill would shut down in the spring and in the fall for approximately four days each period. The shut-downs and start-ups also had potential environmental impacts at the wastewater treatment plant.

Employees at Smurfit-Stone Container looked into the possibility of replacing the ceramic disks with rubber membrane disks. The Ontonagon mill decided to try the membrane disks but first had to justify that the investment would be worthwhile. Because of the significant costs for the materials and installation, Smurfit-Stone Container had to be sure that the rubber membrane disks would be the solution. A team of employees visited the manufacturer of the rubber disks and a Wisconsin mill that had the membranes in place. Based on environmental benefits and return on invest-

ment, they were sold on the project. The disks were installed in the fall of 1995.

Previously, the ceramic disk cleaning was accomplished by spraying first high-pressure water and then a low concentration hydrochloric acid wash.

Results of Revised Process

Smurfit-Stone Container Corporation was immediately pleased with the decision. The rubber membrane disks provided many benefits. The disks have required no maintenance or cleaning since installation, resulting in eliminating mill shutdowns specifically for disk cleaning. With the wastewater treatment plant able to operate during regularly scheduled shutdowns, the mill was able to eliminate the spring outage. Both of these features were a real money saver. It also eliminated the environmental risk of starting up and shutting down the wastewater treatment plant.

The rubber disks operate more efficiently because they do not become fouled or partially plugged. A result is the production of a cleaner effluent by removing more BOD. The rubber membranes are also able to maintain a higher dissolved oxygen rate. After the ceramic disks would foul, they would require more horsepower to maintain the same airflow. Now, less power is needed (a reduction of 200 to 300 hp) which saves energy and money. The mill used six blowers to run the basins with ceramic disks. With the rubber membrane disks in place, only four or five of the blowers are used. This reduction in power resulted in additional savings.

The only disadvantage seen in the future is that the rubber disks will eventually wear out. Their lifetime is estimated at approximately ten years, whereas the ceramic disks normally never wear out but do require cleaning. When asked if the rubber membrane disks would be recycled after use, Smurfit-Stone Container said it would be looking into the possibility.

The project has paid for itself. With the savings generated from reduced power requirements and more production, due to less downtime, the payback time of this project was estimated to be one year. The project was also beneficial to the environment by reducing energy usage and producing a cleaner effluent.

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Teams

By Jeremy Hoeh, MDEQ/CSS Intern

The team concept has been around for years. Teams are usually associated more with scoring points that with improving the efficiency of a business. However, the concept of teams in business has been building momentum over the last decade. Many companies are realizing that a team in the workplace is a great way to get things done. Some of the many benefits of using a team are listed in the box below.

Many proponents of teamwork think it offers the best possibility of achieving exceptional results and increasing employees' personal satisfaction. Teams generally take on more risk than individuals, so they can also attempt a higher level of accomplishment than any one person.

Benefits of Teams

- There are more ideas to choose from
- More facets of a problem are considered because of team members' differing backgrounds or occupations
- Team members unfamiliar with a particular process often ask questions that may have been overlooked by experts
- Fresh approaches can improve a process
- Large tasks may be accomplished more easily
- Different people have different strengths
- New working relationships can boost morale
- Team members are usually more willing to offer help and suggestions for improvement
- Employees may care more about what they are doing and take pride in their achievements
- Productivity and efficiency improve

In the area of pollution prevention, teams can assist with implementation and process changes, demonstrate benefits, come up with capital support, and measure results and savings.

Several Michigan paper mills have used the team concept to solve problems so successfully that they are now implementing more teams to handle different tasks and develop new ideas. This case study describes highlights of what teams have accomplished at Mead Publishing, Georgia-Pacific Corporation and Smurfit-Stone Container Corporation.

Mead Publishing's Paper Division

The Paper Division of Mead Publishing is located in Escanaba. This mill, begun in 1912 as the Escanaba Pulp and Paper Company, has been associated with Mead since 1920. The mill employs approximately 1,300 people full-time. It produces 1,550 tons of coated publishing papers per day, along with 80 tons of pulp.

In Escanaba, Mead has used the team method to tackle some of its bigger assignments. The Productivity Improvement Directors (PID), a group of mill managers from all Operations areas, Finance, Technology and Human Resources, decide on the teams and their topics. Each team's participants are chosen from a variety of departments to expand that team's expertise and views. The teams are given three to nine months to research solutions to a specific problem. One of the PID members is designated to lead financial and policy-making decisions. The team has the ability to implement reasonable solutions without formal permission. Final recommendations are given to the PID for inclusion in departmental plans and budgets if the projects cannot be completed immediately.

A major focus of pollution prevention is reducing or eliminating wastes, not just reusing or recycling them. One Mead team, examining waste generated at the mill, used mass balance techniques to see exactly what the mill was throwing away and assess the cost of disposal. As cost is a major driver in new projects, the findings would help prioritize opportunities for waste reduction and justify their pursuit. The team found that coating products accounted for a large part of the waste costs.

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After the mass balance study, a follow-up team was created to find a better way to control the flow of additives to coating machines, in case of shutdowns. The application of coating products is manually halted when the paper machine is stopped. An additive flow control system would reduce waste by stopping flow immediately after sensing that the paper machine was off-line. By reducing waste through the mass balance/ cost assessment program, the mill will purchase fewer raw materials and be able to assess and implement more environmentally responsible alternatives.

This team has a goal of identifying and quantifying losses sustained by the coating machines. Members are also asked to develop a cost-effective project or procedural change to eliminate the losses. The team consists of members from the Accounting, Technical Services, Paper Operations, Engineering, and Process Control departments.

Mead has also recently set up a water recycling team. Among other objectives, the team will be looking at water reclamation and reuse, with a goal of reducing water consumption by six percent. Two areas of potential reuse at the mill are air conditioner water and steam condensation from throughout the mill's processes. The water reduction team is in the early stages of idea-gathering. The team consists of people from the Accounting, Utilities Operations, Technical Services, Paper Operations, Process Control, Engineering, and Maintenance departments.

Georgia-Pacific in Kalamazoo

Another mill investigating water reduction opportunities is the Georgia-Pacific Corporation's Kalamazoo operation. The original Kalamazoo mill was built in 1867 and became part of the Georgia-Pacific family in 1968. It produces 400 tons of coated and uncoated fine printing papers per day from recycled materials (60 percent recycled with 30 percent post-consumer). The recycled materials are derived from the de-inking facility on site. The mill employs 290 people full-time.

A team established through the mill's Quality Improvement Process (QIP) evaluated the entire mill, including production and utilities, to find cost-saving water reductions. A minimum of eight people are on the water reduction evaluation team.

Other research teams are available for capital cost evaluation. The teams are headed by a steering group overseeing all QIP activities at the mill. Some ideas now being considered involve recycling water into the manufacturing process and reducing water usage by changing practices. As any reduction effort evaluated is found to be practical, steps will be taken to implement the change as soon as possible. "If capital costs are involved, an additional evaluation will be needed," said Senior Environmental Engineer Dan Cummins.

The goal is to reduce daily water use by approximately 2,000,000 gallons. The mill currently uses just under 6,000,000 gallons, so accomplishing the goal would be a significant reduction. All of the used water is sent to the local wastewater treatment plant. The mill is charged approximately $125,000 per month for the amount of water flow, solids composition, and biochemical oxygen demand. Being the largest customer of the treatment plant, the mill and the treatment facility may have a change in their relationship due to the project. Other objectives include actual changes to the process, changing employee behavior, and locating necessary capital.

Smurfit-Stone Container

Smurfit-Stone Container Corporation in Ontonagon is another Michigan mill that is strong on teams. This mill started as a sulfur pulp mill in 1921 under the name of Northern Fiber Company and went through many changes. The mill is currently owned by Smurfit-Stone Container Corporation and employs 277 people. The mill produces 815 tons of brown corrugating medium daily.

Besides using teams to improve the manufacturing process, Smurfit-Stone utilizes the team concept to improve employee relations and the surrounding community. For example, the recycle team, formed in 1994, raised over $6,500 in 1997 for the area schools' computer fund. This was realized by collecting about 42 tons of glossy paper and 147 tons of old corrugated

cardboard and mixed office waste from the facility and the surrounding community. Smurfit-Stone has reduced materials going to landfills by over 20,000 tons. The team is also involved in battery and light bulb recycling and the Adopt-A-Highway program.

The first team was started because of a suggestion by Northern Initiatives of Marquette, a nonprofit organization that helps train employees to become effective team members. This team addressed housekeeping practices. The mill wanted to clean and reorganize some areas to operate more efficiently. This meant using fewer raw materials and producing less waste, the key to pollution prevention. The areas for improvement were photographed and posted on a board so the team members and other workers would see the areas and help improve them.

As a result of the housekeeping team's success, new teams in other focus areas were established. One is the emergency response team, which is in charge of educating workers about what to do in case of a chemical spill or other emergency. All teams meet monthly or bimonthly to keep updated and come up with new ideas.

Another team has studied new ways to test the quality of paper being made at the mill. The pulp and paper test was streamlined to keep up with the increasing speeds of the paper machines. The new methods are now able to keep pace with production and eliminate wasteful practices. A steam team, put in place to analyze the mill's energy use, reviewed and reduced the mill's energy costs.

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