Waste Minimization Opportunities for Industrial Manufacturers

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Abstract

What changes can manufacturers make to reduce waste streams and save money? A recent modification to a successful Department of Energy energy audit program has included a focus on waste minimization for small and medium-sized manufacturers. The program change was incorporated over two years ago and approximately 2000 assessments have been completed nationwide since the change.

This paper will examine the results of the combined energy/waste assessments. It will focus on the typical waste recommendations made for three sectors of Standard Industrial Classifications (SIC) 20-39. Recommendations vary from typical conservation measures such as recycling pallets and cardboard to direct process modifications that reduce water or chemical usage. While some recommendations are general and can be applied to any industry, others are industry-specific.

1. Introduction

The Energy Analysis and Diagnostic Center program (EADC)was established by the U.S. Department of Energy (DOE) in 1978 to assist small and medium sized manufacturers in improving energy efficiency while training engineering students in energy efficiency principles. This was accomplished by establishing EADC's at thirty universities around the United States. The EADC's were tasked with completing energy audits for thirty manufacturers within a 150 mile radius of their campus.

In 1993, DOE restructured the program and began converting EADC's to Industrial Assessment Centers (IAC). This change introduced waste stream analysis into the program. The new IACs were trained in waste management analysis to augment their knowledge in energy efficiency. Client assessments were then improved by combining energy efficiency recommendations with waste management opportunities.

One of the strengths of the IAC program is the detailed records maintained by the Department of Energy. Information from all assessments is electronically uploaded to a national database which is maintained by Rutgers University. [1] This database is available to the general public and allows for statistical analysis of various aspects of the program. The data used in this paper comes directly from that database. The program has also generated excellent training materials which can be quite helpful to manufacturers. [2,3]

At the time of this writing, the database held the results of 1,926 combined assessments. These assessments included 13,712 recommendations yielding an average of seven recommendations per report. While these assessments were completed for manufacturers in SIC code 20-39, not all manufacturing areas received an equal amount of assessments. Table 1 lists the industry descriptions for each SIC code. Figure 1 illustrates the number of reports completed in each industrial class.

SIC	Industry
20	**Foods**
22	**Textile Mills**
23	**Apparel**
24	**Wood Products**
25	**Furniture**
26	**Paper Products**
27	**Printing**
28	**Chemicals**
29	**Petroleum**
30	**Rubber & Plastics**
31	**Leather Products**
32	**Stone & Glass**
33	**Primary Metal**
34	**Fabricated Metal**
35	**Ind. Machinery**
36	**Electronics**
37	**Trans. Equipment**
38	**Instruments**
39	**Misc. Mfg.**

Table 1 - Standard Industrial Classifications

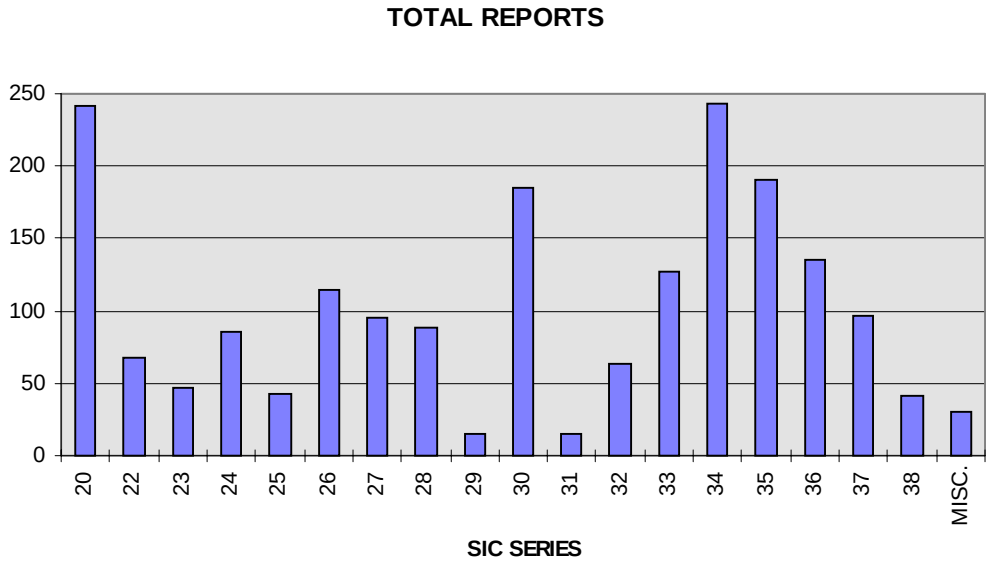

Figure 1 - Total Reports vs. SIC Code

As can be seen, the largest amount of assessments were done for SIC 20 (Food Products), SIC 30 (Rubber and Plastics) and SIC 34 (Fabricated Metal). Thus, this paper will discuss the lessons learned from work with those three industries.

2. SIC 20 - Food Industries

The food industry has received the largest percentage of the industrial assessments performed. The average food manufacturer had annual sales of $49 Million, 149 employees, and received seven waste minimization recommendations from their IAC assessment. Many of the waste minimization opportunities recommended involved the reduction of water or non-hazardous solid waste. Figure 2 illustrates the average water cost for each SIC class.

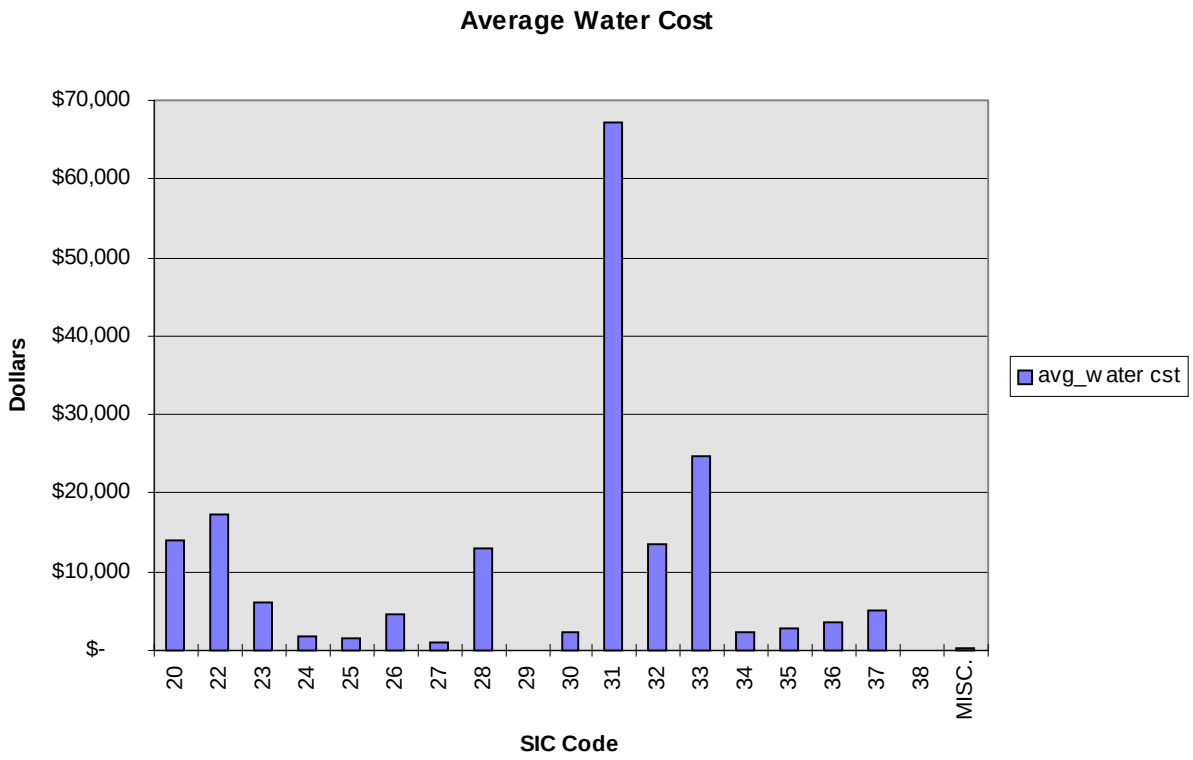

Figure 2 - Water Usage Costs

Due to the food processing requirements by the Department of Agriculture, the industry must use large amounts of process water. This is the greatest waste stream cost for food manufacturers. The average manufacturer spends $14,000 annually on water usage. This places them fourth in terms of average water cost for the total manufacturers surveyed.

The second largest waste stream cost is non-hazardous solid waste. This is due to the usage of packaging material in food manufacturing. The average food manufacturer spends $8,695 annually for disposal of non-hazardous solid waste. Considering that the average total waste cost for food manufacturers is $24,771 annually, it is evident that these two area represent the largest waste stream costs.

The recommendations made by IACs reflect this relationship. Fifty percent of the recommendations were aimed at water reductions while 32 percent involved the reduction of non-hazardous solid waste.

The reduction of water use in industrial facilities can often achieve dual savings. By reducing the use of process water, sewer saving may result as well. Water costs for food manufacturers can be reduced by examining four different areas. The first involves employing closed cycles for water use. Often water is used to cool cooked foods before packaging. Many manufacturers will use a one time spray operation for cooling the food. The waste water from this process can usually be recovered and reused. If the water needs to be cooled before reuse, the application of a cooling tower can usually be adequate

and still cost effective. Water may also be treated chemically before reuse to remove undesirable materials.

The second area involves improving water quality within the process. By minimizing contamination of water used in process, water quality is improved which reduces the treatment requirements and cycle losses. Examples of recommendations improving water quality are; applying deionized water in upstream rinse tanks or establishing a maintenance routine for cleaning fouling from water lines.

The third area is the improvement of water treatment after the process. In many facilities, the use of oxygen or ozone stages in water treatment can replace the costly chlorination stage. In cases where this isn't the case, one can recycle the chlorine stage process water to achieve savings. The application of magnetic technology to treat water can achieve savings as well.

The final source for water use recommendations is general reduction strategies. At the end of production shifts, large amounts of water can be consumed for cleaning. Many facilities use high volume fixtures and valves which may be adequately replaced by lower volume units. This may require the installation of booster pumps to provide increased water pressure. The repair of small leaks in water lines which may appear insignificant can achieve large savings. Manufacturers are often encouraged to meter waste water for closer tracking of water costs and differentiation between water and sewer costs.

The majority of solid waste recommendations for food processors involve the reduction or reuse of cardboard, pallets and plastic packing materials. Recycling companies have increased over the last five years and it is difficult for manufacturers to keep track of available providers. In Maine, we found three different manufacturers receiving far different compensation for their waste cardboard. One was paying to remove their cardboard, another had theirs hauled at no charge and the third was receiving considerable income from their waste cardboard. Food manufacturers can achieve considerable savings by allotting time to study markets for their waste products.

SIC 30 - Rubber and Plastics

The IAC program has completed 185 assessments of rubber and plastics manufacturers. The average manufacturer in SIC 30 had annual sales of $21 Million, 154 employees and received 7 assessment recommendations. The major waste cost in this industry involves processing the large amount of non-hazardous solid waste they generate. Figure 3 illustrates that SIC 30 has the third largest waste cost associated with non-hazardous solid waste.

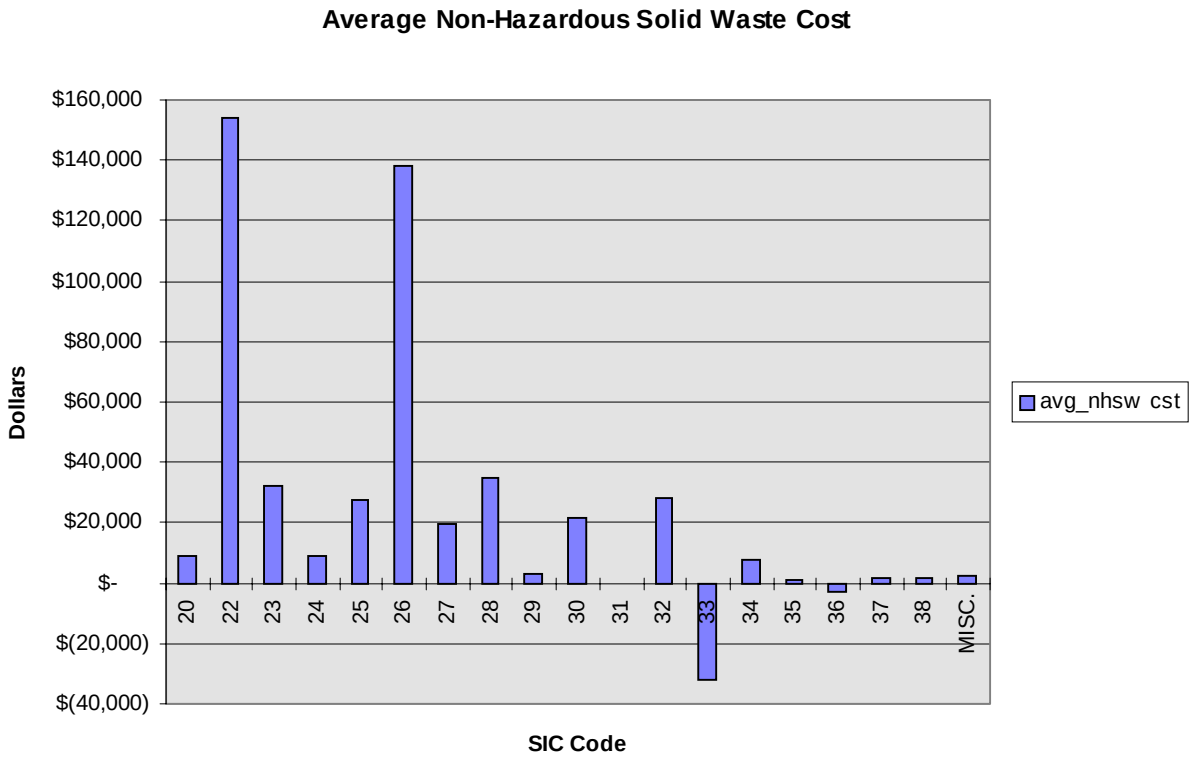

Figure 3 - Non-Hazardous Solid Waste Costs

This is the most significant area where plastics manufacturers can achieve waste savings. The average plastics manufacturer generated $21,755 in waste costs though, so there are certainly saving opportunities in other areas as well.

Plastic manufacturers often overlook the possibility of selling their waste scrap. Plastic shavings, pipe end protectors, etc. can be sold to recycling companies for profit. There are also a significant amount of packaging materials such as paper, cardboard and steel bailing straps which can be recycled as well. Finally, rubber manufacturers can often recover excess solvents from their waste rubber to reduce raw materials costs.

SIC 34 - Fabricated Metals

The IAC program has completed 243 assessments of fabricated metals manufacturers. The average manufacturer in SIC 34 had annual sales of $24 Million, 166 employees and received 8 assessment recommendations. The waste costs in this industry involve both non-hazardous liquid and solid waste disposal as well as water usage.

Liquid waste reduction can be completed by examining the usage of oil, acid, cleaning solutions and paint. Metals manufacturers use hydraulic oil in many machines which can be filtered and reused. Cleanup rags should be reused until completely soiled, sized correctly for their use, and washed for reuse where possible. Acid baths and other cleaning solutions are used for parts treatment and these baths are often candidates for recycling. Usually chemicals can be recovered from the baths and reused. Solvent cleaning systems may be replaced with ultrasonic systems

For metals manufacturers that paint their final product, changes in the painting process can reduce waste. One consideration is replacing conventional paint processes with electrostatic powdered paint. Also, conversion to high volume low pressure (HVLP) guns creates savings. Where possible, paint lines should be shortened to reduce cleaning waste. Finally, close examination of spray painting may yield simple changes to reduce overspray.

Water and sewer costs can be reduced by recovering and treating certain gray water. White water can also be reused in other applications in the facility. Cooling water can be recovered and run through cooling towers for reuse. Metals can be filtered from water streams and recycled.

Summary

There are many opportunities for industrial manufacturers to reduce waste costs in their facilities. To accomplish this, they must examine where their waste streams and monitor them closely. Then, they can reduce costs through process changes, implementing new technologies or selling waste products to recyclers.

This paper reviewed opportunities for three manufacturing sectors in detail but many of the suggestions offered are applicable to all manufacturers. The key to saving money is taking the time to calculate the potential savings. Manufacturers often realize where savings may occur but dismiss the opportunity by assuming the savings will be minimal. The average annual waste savings per client served by the IAC program was $20,000 in the 1994 Fiscal year. [4] These savings were available with under a three year return on investment. Small ideas can yield significant savings.

References

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Biography

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