

Methods for Managing Environmental Costs

By John S. □
Schroeder □
& Harry L. □
Schroeder

Considering environmental costs as part of the cost of production will aid in overall cost reduction and a closer examination by everyone of manufacturing process. Your accounting department can help.

Properly managing your production process is the most effective means of reducing polluting emissions and their attendant costs. This idea should be self evident, but is often ignored.

Reduction of pollution at the source has become the guiding principal for the development of new processes and environmental regulation. California and other states have enacted regulation requiring manufacturers to evaluate new manufacturing technologies that will result in lower emissions on a regular basis and to adopt those that are economically viable. Manufacturing process suppliers have, in recent years, developed a number of processes that eliminate or reduce emissions. The technological gains have been significant and worthwhile.

Many companies, particularly smaller firms, do not consider the principle of source reduction as related to their continuing operations. When evaluating new processes, most companies routinely examine their emission control system's ability to handle the emissions produced by the new process. They then compare the capital and projected operating costs of processes at various emission levels. Generally, they do not use the same methodology when evaluating existing operations and costs. It has been our experience that much of the cost associated with pollution results from mistakes made in manufacturing processes. That mistake is then shipped to the environmental department that either cannot handle it or is unaware of it until it is too late.

The current accounting practice treats environmental costs as a part of general overhead not allocated to other departments. While overhead comes off the bottom line of a company, it does not tie those costs directly to their source. This means of accounting does not promote source reduction within a manufacturing department since environmental costs are not considered a cost of operating that department. "You get what you measure" is an old axiom that is a shorthand way of saying that you obtain the results that you target and measure. If you measure and judge performance of personnel on the attainment of sales, you will attain sales. If you measure and judge people based on profits, you will be profitable. By including the cost of dealing

with polluting emissions when judging the performance of the emissions-producing department, management can better control the associated costs.

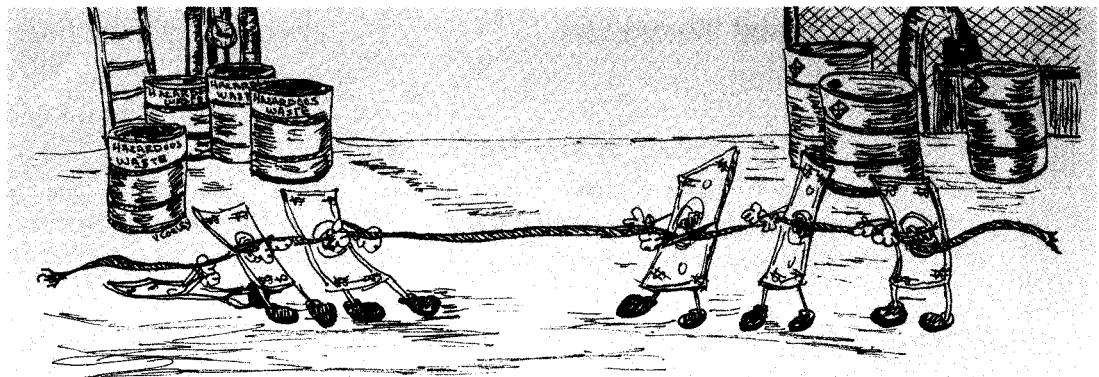
Source reduction incorporates more than using a new manufacturing technology. Source reduction includes things like changing procedures on an existing process so that less waste is generated. For example, suppose a given operation always results in a certain amount of spillage. In many cases, such spillage will be handled by washing down the floor and giving the waste to the environmental department for treatment and disposal. The cost of this gets folded into overhead and not charged directly to the manufacturing department. Charging the costs directly to the department would cause an examination of the process to see if there is a way to eliminate the spillage, and thus eliminate the washing waste.

Your accounting system should be the tool used to define your method of performance measurement. Popularly, accounting appears necessary only for purposes of complying with Internal Revenue Service requirements. Your accounting system should be the measurement device by which you gauge the progress of your business. Truly, the IRS requires you to accumulate accounting information that is more elaborate than you need to simply manage your business. The IRS requirements also take on more urgency than basic business accounting. However, you should view IRS requirements as a by-product and not the main purpose of your accounting system. The purpose of your accounting system should be to provide you with information needed to manage your business.

The environmental department is a service department, not an overhead department. This distinction requires that the services of the environmental department be charged to the manufacturing department using them. In this way, manufacturing departments "pay" for their own environmental costs.

The advantages of accounting for environmental costs in this way are multiple. The onus for source reduction transfers directly to the generating departments because each department will be charged for the waste it generates. This

Figure 1.
There is a constant tug of war between production and waste dollars.



transfer of responsibility will have the further effect of causing Manufacturing to become active in environmental issues. Most companies react to rather than plan for environmental requirements. For example, when considering a new process, environmental issues generally arise only after the basic process has been selected. Planning for treatment technologies and requirements for permitting are an afterthought. The methods of accounting can force such considerations to become an integral part of process evaluation. The costs of dealing with the emissions produced by a process are integral in the capital and operating cost projections of the project. All of this should result in an ultimate cost savings. Better planning for expenses results in better control. The reduction of waste created by effective planning will also control costs.

Manufacturing's responsibility for environmental compliance becomes more apparent with this method of accounting. Because each manufacturing department will have to effectively pay for its waste production, its members will quickly respond to correct the actions that result in higher costs to them. Suppose the accidental contamination of a processing bath occurs. The most expeditious way to correct this problem is to dump the bath and make up a new one, thus minimizing downtime and keeping production moving. Yet this dump may create considerable cost to the environmental department for treat-

ment, disposal and reporting. If the manufacturing department directly incurs this cost, it might become worth some downtime to correct the problem. The result of this could be a reduction in waste produced and a reduction in total cost to the company.

The charging of environmental costs to manufacturing department should also make pricing easier and more precise. Overhead is traditionally the most difficult factor to incorporate in pricing calculations. Traditional methods for incorporating overhead can fail miserably when including environmental costs. Typically, prices incorporate overhead as a percentage of other costs. When overhead includes environmental costs, the percentages do not follow any traditional patterns and are difficult to determine. Furthermore, environmental costs vary directly with manufacturing activity. Some products manufactured at a facility may result in far higher environmental costs than others. Placing environmental costs in overhead distributes the costs over all products, thus inflating the costs of some products while underestimating the cost of others. Calculating actual figures for environmental costs per unit should result when manufacturing bears environmental costs, and pricing becomes much more precise. Higher prices on environmentally intensive products are easier to justify with this accounting method. Better justification for pricing should also aid sales as it will remove

the arbitrary appearance of price increases.

A final benefit of charging environmental costs directly to manufacturing is the improvement of data used when discussing environmental laws and regulations. As anyone who has participated in discussions with government on new regulations knows, hard data is vital to making a point. Too often companies make complaints about new regulations because they "feel" as if enough is enough. Accounting methods such as those proposed here simplify the creation of accurate figures on costs, sales, benefits and liabilities of current regulatory requirements. Such figures also serve as an excellent base for projections of the same figures for new regulation. Such figures make discussions on new regulation far more productive.

The stricter accounting proposed here will require higher levels of discipline on the part of those who adopt it. For example, in some situations, chemicals used in treatment come from production inventories. With the proposed methods such actions require strict accounting or separate inventories. Stricter records of emissions are imperative. While this seems annoying, it has the benefit of making report preparation for various agencies easier when they come due.

The actual methods for doing this accounting have precedent, but can be complicated. Environmental costs for a manufacturing firm fall into four basic categories: capital equipment;

cost of materials; fees, fines and taxes; and personnel. Personnel costs include much more than the salaries of the people who work in the environmental department. Regulation often requires labor-intensive activities such as reporting, application preparation, testing and compliance auditing. You will need to prorate some of these costs. For example, a single sewer permit may exist for a facility with multiple departments generating waste water. Taxes are on total waste production with minimal distinction of type. Environmental personnel will obviously work with emissions from many departments. Certain capital equipment may serve the needs of numerous departments. Fortunately, accounting practices exist for handling all of the problems encountered.

The proposals in this article require good cost accounting systems and practices. Such systems are vital to survival in today's highly competitive business atmosphere. Not only is good cost accounting necessary for the ideas presented here, but it is a powerful tool for generally managing a business. As a start to adopting the proposals in this article, we advise a review of general accounting practices. Such a review will aid your business beyond the scope of managing environmental costs.

A good cost accounting system begins with a method to properly justify capital expenditures prior to making commitments to those expenditures. The name for this justification is often "Authorization of Fixed Expenditures," or "AFE." An AFE should include not only the initial costs but also a measure of the projected impact of operating costs. All costs should be factored into the preparation of an AFE. For example, if you are considering a revision or replacement of an existing production component, the analysis should incorporate any capital improvements necessary in your treatment and control equipment and the costs of operating same. Failure to incorporate these considerations in AFE preparations can result in some rather rude surprises when the actual changes occur.

The AFE system needs some modification when considering capital expenditure on treatment and control equipment. Unfortunately, such expenditures generally appear mandated, rather than strictly for cost reduction purposes. The modifications proposed are in the measurement basis rather than in the procedure itself. A recent client of ours installed a waste water treatment system. Upper management was hesitant to make the expenditure, even with local authorities requiring it, because it looked strictly like "money out the window." Only when middle management realized that—because of the regulatory requirement—contracting out the emission-producing processes was the only other option, did the upper management truly get the picture. When the AFE compared the treatment equipment investment to using outside services, the picture became very clear: purchasing the treatment equipment

saved money.

AFE's are easier to prepare for improvements in treatment equipment. More efficient treatment equipment is easily justifiable. Often neglected in improvement justifications is the added efficiency that comes from more reliable compliance. For example, if a company routinely pays fees or fines for emissions, and an improved treatment system would reduce those fees, those fees are a part of an AFE. Maybe the system does not function reliably, requiring the submission of reports explaining the violations a couple of times each year. The cost of reporting should be a part of any AFE justifying an improvement.

Using good cost accounting can become very complicated for regular operating expenses. You

may have to go to some capital expense to make good accounting for operating costs possible. Knowing how much each department uses the environmental department and its equipment is the most vital information to the entire system. Gathering this information requires measurement. Air or water flow metering and logging equipment is the most direct and accurate means of determining this information. The information obtained in this manner will be useful for determining both direct costs and for prorating equipment depreciation, regulatory fees, and personnel costs.

Engineering and scientific knowledge is also vital to good cost accounting. Determining the consumption of a treatment chemical to treat wastes can be difficult empirically. Treating dif-

Table 1. Sample of environmental cost spreadsheet.

Supervisory Hours: (\$25.00/hour)	Labor Hours: (\$15.00/hour)	Shipment of 10 tons of sludge:
2 hours filing reports	6 hours batch treatment for plating	\$2,059.67 charged to plating
4 hours in direct supervision	1 hour batch treatment for photo	\$1,080.25 charged to etching
2 hours troubleshooting	2 hours batch treatment for etching	\$ 360.08 charged to photo
	4 hours on continuous treatment	
	3 hours doing inventory	
	(no special jobs for date)	
Total Cost: \$200.00	Total Cost: \$240.00	Total Cost: \$3,500.00

Average daily heavy metal output by department: 143 pounds from plating
75 pounds from etching
25 pounds from others

ferent wastes from different departments simultaneously is a particular case in point. In some cases, mixing wastes reduces total treatment costs since some wastes neutralize each other. In other cases, mixing wastes for treatment increases efficiency because they are similar in composition. Inventory consumption versus amount treated calculations will not result in an accurate unit cost for treatment in such circumstances. Fortunately, it is possible to calculate the amount of a treatment chemical used to treat a certain stream, but such calculation requires engineering knowledge. The development of formulas for use in cost accounting is a vital part of the engineering function's support of the environmental department. Such formulas can always be reduced to simple algebra, but their derivation is very complex.

The cost formulas derived by engineering will have an important impact on the placement and amount of metering and logging required. Formulas must minimize the amount of capital investment required to gather data for the calculations while producing data that is useful and accurate.

Prorating the fixed costs of operating an environmental department is a topic worthy of some discussion. You are aware that to prorate a cost is to divide that cost on some basis so the apportionment of those costs is equitable. The basis chosen for division can radically affect the results of the calculation. For example, suppose that a single carbon bed handles the solvent emissions from two sources. Both sources produce an equal air flow, but one source has a much higher concentration of solvent than the other. In this situation, what costs would need to be prorated? The first such cost is for regenerating the bed. There are various methods for producing a "fresh bed, but which method is immaterial to this discussion? The second such cost is the fee and permits required to operate the bed. The third such cost is for personnel to operate the bed.

On initial inspection, prorating these costs on the basis of the total air flow from each source seems appropriate. To prorate in this manner would not produce an equitable assignment of the costs. Regeneration of a carbon bed depends not on the amount of air flow, but on the amount of contaminant—solvent, in this case—that the bed removes.

The pounds of solvent emitted are clearly a better basis upon which to prorate the regeneration costs. Unfortunately, measuring this basis is much more difficult than simply measuring the air flow. Monitoring equipment to determine the pounds emitted is prohibitively expensive to use at numerous locations. Again, engineering formulas can be very useful. It is possible to reasonably estimate emissions based on production figures. Engineers perform such a calculation, called a "mass balance," every day.

Depending on the locale and nature of the treatment method, fees and permits can be either a fixed annual fee, or a fee based on total

emissions. In the case of a fixed annual fee, flow is the most equitable means for prorating the costs. If fees depend on emissions, then those emissions are the best basis to prorate the fees. In a neat coincidence, the reports given to the regulating agency will contain all the data necessary to determine how to properly prorate the costs.

Personnel activity depends strictly on amount of time the unit operates, a function of total flow. In an ideal world, environmental personnel would maintain time records, but such a system could be oppressive and burdensome. Therefore, the flow rates are the best basis for prorating the personnel costs.

Consider another situation. In this situation, a single hydroxide-based precipitation system removes metals from waste waters produced by two departments. Each department produces relatively equal flows. One department has higher concentrations of metals in its waste water. The higher concentration department will consume more treatment chemicals, naturally reflected in the direct cost calculations discussed earlier. However, the fees vary with the total flow released to the sewer system. In this case, use flow to prorate the fee costs, not concentration. A third cost associated with this situation is the disposal of the sludge produced. Sludge production is directly proportional to the concentration of metals in the waste water. As in the case above,

concentration is the best basis for prorating the disposal costs. Engineering calculations will again play a vital role in the determination. As with the solvent case, monitoring equipment is prohibitively expensive for regular use. Mass balance calculations can be very cumbersome for the types of operations that produce metal-bearing waste waters. In this case, the best means to gather baseline data would be regular sampling for a limited period and the application of statistical tools to project that data over a given financial period.

Neither of these scenarios has addressed how to handle depreciation of the treatment equipment. Typically, treatment equipment ages as a function of the clock, not workload. Thus, it is better to prorate depreciation on the basis of percentage of time a given manufacturing department uses the equipment. This time is directly proportional to the total mass of material treated, irrespective of contamination present in that material. Thus, flow is the best basis to prorate the depreciation of the treatment equipment.

Good cost accounting like that described in this article requires personnel with good experience and knowledge. As seen here, the proper allocation of costs is very complex. Strong engineering and accounting ability are necessary to make a system, like that proposed, function. However, the availability of relatively

inexpensive computers and software make such an accounting system possible for a business of any size. If you find the task of setting up such a computer daunting, you may want to consider the services of a consulting firm. After a few months, a good consulting firm should have you able to do this on a regular basis with minimal difficulty.

Environmental costs have become significant for almost any manufacturing business. There is a tendency to view those costs in a similar manner to taxes: as a charge imposed by the government. Environmental costs are, in fact, a cost of production and should be viewed as such for all purposes. This concept seems basic, but the manner in which you view environmental costs will greatly influence how you make decisions concerning those costs.

Any business tries to keep its production costs to a minimum. Considering environmental costs as a production cost will automatically bring it under that cost reduction umbrella, in such a way that it is ever present in the minds of all personnel. Your accounting system is the best tool available to create that viewpoint. **C**

John S. Schroeder and Harry L. Schroeder are consultants with the firm Salmon and Schroeder, Inc., of La Crescenta, Calif.