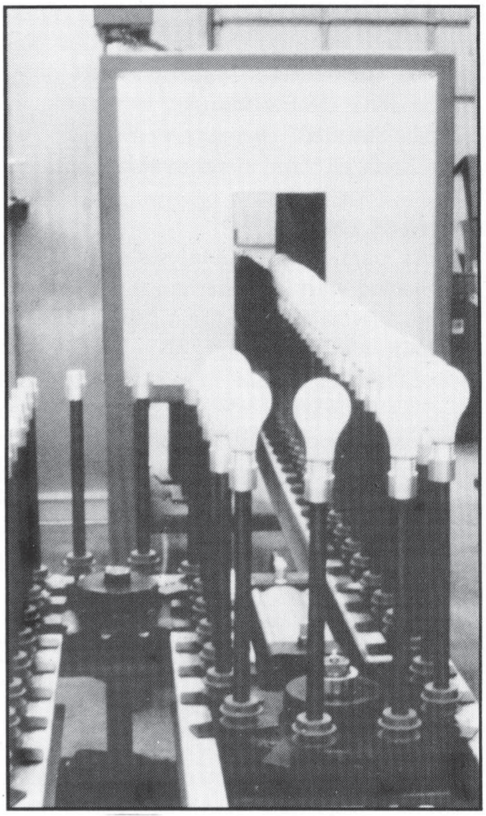
HOW CAN INFRARED SAVE MY COMPANY MONEY?

DECISION-MAKING CRITERIA

So, you want to add an Infrared Heat Processing System to your production equipment. In making this important decision for your company, a complete analysis of the project costs should be completed. Typical questions to be asked include:

- What are the acquisition, operating and maintenance costs of the equipment?
- How do these costs translate into a cost per produced part?
- How will product quality be affected by the equipment?
- Should I supplement my existing system or replace it?
- How do I choose between a gas or electric system?
- How do I create a break-even analysis between alternative systems?



Powder Coating System cures teflon and polyurethane powder coatings onto light bulbs of various sizes. The system includes an infrared preheat and cure oven, and spindle conveyor.

ACQUISITION COSTS

As part of the acquisition costs— the costs to get a system installed and running in your facility—one must consider all of the following:

Purchase Price

Compare prices for alternative systems of equivalent scope of equipment delivered to your facility. Comparisons should also be made as to payment terms, warranty offered, delivery schedule, availability of spare parts, etc.

Scope of equipment should be evaluated to determine if it is truly equivalent. Factors to compare include the proposed heat capacity of the system (KW or BTU), how long parts will remain (dwell) in each portion of an oven (ramp temperature section, hold temperature section, etc.), the overall oven dwell, flexibility of systems for expansion and/or process changes (updated/new products being finished, different coatings being used, etc.). Are proposed equipment components able to work reliably in the process environment (e.g. is an exhaust blower provided that will be able to handle to process heat and move the air (CFM) properly), and do all proposals provide zoning and/or power management capabilities to turn off a portion(s) of the oven part of the time and/or stage system turn-on to minimize operating costs? Your prospective vendors as part of their proposal will detail these items for you.

Engineering And Administration Time

Consider how much of your resources will be required to review the project specifications and proposals from each vendor (including process verification test results), travel to the vendor to inspect the system or attend acceptance run-offs at the vendor's location or at your facility, just to name a few.

Installation

Will installation be done by the supplier, outside contractors or your in-house maintenance department? How will the vendors supply the equipment to your plant—fully assembled, assembled in their factory and broken down for shipment, or total first time assembly on site? What utilities will be required—electric, gas (natural or propane), water or compressed air? Are utilities at the installation site? Will existing utility services handle the new equipment requirements? If not, what is required to upgrade/expand the existing utility services? Is outside air required to be combined with recirculated air before it is exhausted?

Training

Time will be required to train your personnel to operate and maintain the new equipment. During the training period, yields on the system may be below expectations. How much time will be required to achieve acceptable production yields?

OPERATING COSTS

Cost of Utilities

Natural gas is sold in units of therms (100,000 BTUs) or per 1000 cu ft of gas (1,000,000 BTUs). Electricity is sold in Kilowatt-Hours and often with a Demand Charge in Kilowatts.

In evaluating the cost for utilities to add a new system to your plant, one must calculate at the marginal rate. Often you pay a higher rate for the initial units of energy, and as the units used increase, the cost per unit decreases. When adding a new system, the operating cost is calculated at the marginal rate or the lowest rate that you are currently paying. An incorrect—and most likely, overly large—projection will be made if one just averages the utility bill to determine the unit cost of energy.

Your prospective vendors, as part of their proposal, will give you the connected utility requirements and an estimated operating requirement. Prospective vendors will also perform an electric vs. gas consumption/operating cost analysis for you (this is discussed in detail later in this article). For natural gas, calculations are based upon cu ft of gas consumed per hour. Electric rates are calculated based upon Kilowatts used per hour (KWH) plus a demand charge. The demand charge is to cover costs by the utility to ensure that they have available peak power/capacity when you need it. Demand charges are often calculated by measuring the highest average KW usage within any 15 minute period during the month. Energy management can keep demand charges at a minimum by staging (staggering) the start-up times of your production equipment.

Often, utility companies will offer time of day rates, with higher costs during peak hours (such as daytime) and substantially reduced rates during the night. Other rate differences

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may be found between summer and winter months. All these factors must be considered in determining yearly operating costs.

With the deregulation of utilities, large users may be purchasing energy at the source and paying a transport company to deliver the energy to the plant. For example, you can buy natural gas at the well head, paying the provider and then contracting with a pipeline company to bring that gas to your plant, paying the pipeline company for use of their pipe. The electric industry is moving in a similar direction. Therefore, in evaluating your true costs, all components must be considered.

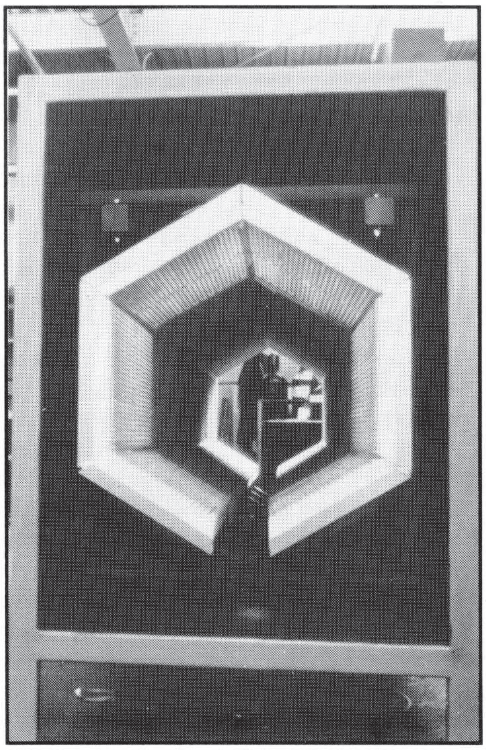
Direct Labor

As part of your analysis you may be presented with two alternative systems, one more automated than the other, or one with a more efficient design, allowing for fewer operators. A vendor may offer options to reduce operating labor, which should be evaluated for cost justification.

Direct labor is a significant cost that should be included in the cost per produced part. Savings of labor may allow you to purchase a more efficient system—a short-term payback.

Reliability

Your evaluation should include consideration of the initial cost of the system versus the reliability of the system components quoted by the vendor. Availability of spare parts from your inventory or from the vendors, cost to replace these parts and down time are all part of the picture. Sometimes paying slightly more for the best components will pay you back with significantly less downtime and maintenance costs.



Preheat section used infrared heaters to dry/cure painted welded pipe.

Small Parts Inventory

How many spare parts should be kept in your inventory and what parts are available for immediate shipment from your vendor in case of an emergency? These are support costs for your system.

MAINTENANCE COSTS

Preventive Maintenance

Preventive maintenance is prescheduled work done on a system to ensure that it will not fail during normal production time. Preventive maintenance includes cleaning, lubricating, changing filters, checking and tightening critical connections, etc. as recommended by the system manufacturer. The cost of preventive maintenance consists of both materials and direct labor. When scheduling production, time must be scheduled for preventive maintenance. Maintenance agreements can be created with outside vendors.

Unscheduled Maintenance

Even with the best preventive maintenance plans, components will fail and systems will have to be shutdown for repairs. Contingency costs for material and labor should be included in your evaluation.

Life Expectancy

Even with good preventive maintenance, systems will become obsolete or require significant repairs. The initial quality of a system may be reflected in its life expectancy, downtime and cost to keep in operation. From an accounting point of view, life expectancy may be different from the actual productive life of the system. Considerations should also be given to upgradability and expansion. Systems can be designed in modular form or are predesigned to accept expansion.

PRODUCT QUALITY

Quality issues include system rejects, repeatability of the process, product finish, how parts fit together after they are coated and the coating is dried/cured, uniformity of one product to the next, etc. This is a subjective evaluation. Most often, all systems that reach your final evaluation stage have similar quality capabilities.

UNIT COST

In calculating unit cost we consider acquisition costs, which will be spread over the life of the system or amortized over a predefined period or a predefined volume of parts produced, operating costs, maintenance costs, and quality. Rejects and downtime increase the cost of operating the system, increasing unit costs.

With unit cost figures in hand, you can determine the cost to produce your product. Often, the acquisition cost appears to be high; however, once a unit cost calculation is complete, one realizes that the project costs have minimal impact on the cost of the product.

SUPPLEMENT OR REPLACEMENT?

Goals of increased production rates, high quality and utilization of environmentally safe coatings can be achieved through the addition of an IR preheat or post heat system. These goals can also be achieved through the acquisition of an IR preheat/cure system to replace existing equipment. Which is the correct answer for your company's needs? Questions to consider include:

- Do I have the production requirements for new or additional equipment?
- What level of capital is available?
- How will either solution affect my unit cost?

Chart 1

Comparison Chart For Alternate Vendors

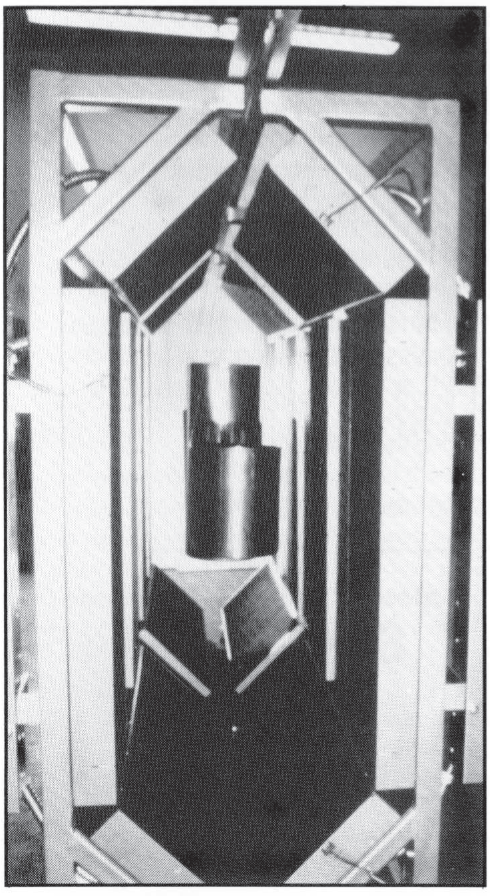
	Vendor 1	Vendor 2	Vendor 3
Production Specifications			
Production Rate - Parts/Hr - Feet/Min			
System Length			
Connected Load			
Estimated Consumption			
Other			
Acquisition Costs			
Purchase Price			
Freight			
Initial Spare Parts Order			
Engineering Time - Pre-Order			
Engineering Time for Acceptance			
Purchasing Time			
Travel Expenses - All Departments			
Installation Materials			
Installation Labor			
Utilities Upgrade			
Facility Upgrade & Changes			
Removal of Old Equipment			
Training / Startup			
Total Acquisition Costs			
Operating Costs			
Yearly Utility Costs			
Yearly Direct Labor Costs			
Yearly Consumable Parts			
Yearly Supervisory / Indirect Labor			
Total Operating Costs			
Maintenance Costs			
Preventative Maintenance Materials			
Preventative Maintenance Labor			
Unscheduled Maintenance Materials			
Unscheduled Maintenance Labor			
Down Time For Maintenance - Scheduled & Unscheduled			
Total Maintenance Costs			
Quality			
Special Features			
Component Selection			
Warranty			
Environmental Concerns			
Other Considerations			
Total Acquisition Costs			
Yearly Operating Costs			

- If I am changing my product/coating to comply with customer requested or government mandated specifications, which will get the job done?
- What labor savings might there be?
- What energy savings or expense will there be?
- Do I have the utilities available?
- What will be the cost to install additional versus new equipment, including downtime for production?
- Is there sufficient life expectancy in the product to warrant a change?
- Do I have flexibility for additional process changes with either solution (e.g. new products, existing product changes, coating changes, etc.)?

Advantages of supplemental equipment include the least cost investment, shortest downtime (least disruptive to production), achievement of goals for quality and production with the least amount of training needed (including maintenance changes).

Advantages of replacement equipment include the potential for:

- Labor savings due to more efficient design
- Higher quality, since design is specific for current production conditions
- Less downtime and maintenance
- Lower operating costs due to more efficient design
- Less floor space required than what is currently being used.



Infrared oven to cure / gel two types of powder coatings on flower pots: a clear coating on the outside and a black costing on the inside.

Choosing Gas Or Electric

In evaluating new systems, gas versus electric, the major differences will arise in the areas of floor space, availability of utilities, operating costs, initial cost, installation cost and maintenance. These variables must be reviewed for each project, as they will change from plant to plant and location to location. One system that has been justified in one plant may cost out totally differently in another. Chart 1 provides the basis for a full evaluation of different systems.

Break Even Analysis

Once initial and operating costs are determined, weighing the difference between one system whose initial costs are higher and operating costs are lower against a system whose initial costs may be lower and operating costs higher, a decision can be made. Every company has its own criteria to justify an expenditure. Typically, a project will be accepted —assuming funds are available—if payback or breakeven is within one to three years.

Chart 2

	Electric IR	Gas Convection	Gas Catalytic IR
Production Rate - 400 Parts/Hour			
Initial Cost	$227,000	Est. $350,000	Est. $275,000
Installation Cost	$15,000	$25,000	$25,000
Maintenance	$1,500/year	$3,000/year	$2,000/year
System Length	49 feet	70 feet	60 feet
Power Cost	$.05/KWHR	$.57/Therm	$.57/Therm
Connected Load	1386 KW	Est. 3,500,000 BTU	Est. 2,600,000
Operating Load	600 KW	Est. 3,000,000 BTU/hr or 30 Therm/hr	Est. 2,300,000 BTU/hr or 23 Therm/hr
Cost/Hour	$30.00/hour	$17.10/hour	$13.11/hour
Cost To Operate			
Cost/Year One Shift (2,000 Hours)	$61,500 (Cost/hr) (# hr) + Maintenance Cost	$37,200	$28,220
Two Shifts (4,000 Hours)	$121,000	$71,400	$54,440
Four 21 Hour Days One 8 Hour Day (System "Idled" for 3 hours/day at 25% Operating Load)	$142,500	$81,225	$62,273
Three Shifts (6,000 Hours)	$181,500	$105,600	$80,660
Break Even Analysis			
Total Installed Costs	$242,000	$375,000	$300,000
Δ Initial Cost	0	$133,000	$58,000
Break Even Point:			
One Shift	0	5.5 Years	1.8 Years
Two Shifts	0	2.7 Years	11 Months
Four 21 Hour Days One 8 Hour Day (System "Idled" for 3 hours/day at 25% Operating Load)	0	2.2 Years	7 Months
Three Shifts	0	1.8 Years	6 Months
Other			
Overall Length	49 feet	70 feet +	62 feet
Environmental Concerns	None	CO, CO_2, NO	CO_2, H_2O
Permit	None	Required	None
Major Service	None	Yes	Minimal
Life Expectancy	15+ Years	15+ Years	15+ Years

Chart 2 illustrates an actual example where a customer was evaluating the differences between an electric IR system, a gas catalytic IR system and a gas convection oven. Data were provided by each vendor for each system. It is assumed that all systems will produce equal product quality with the same number of direct labor hours. This example is for this specific customer only and may not be applicable in other circumstances... each case is different.

Also in Chart 2, basic acquisition costs and operating costs are compared. The electric system offers benefits of lower acquisition costs and smaller floor space footprint than the other alternatives; however, the hourly operating cost is higher. In this example, on a three shift/year operation, the electric system will cost almost $100,000 more to operate than the gas catalytic alternative. Based upon a single shift operation, the savings in utility costs by operating the gas catalytic system would make up the difference in acquisition costs in 1.8 years. After that point, there will be savings over the other alternatives in a two-shift operation with the break even point reduced to 11 months, and a three-shift operation will reach break even in six months.

In most companies, all of these break-even points would indicate that a purchase of the gas catalytic system is in order. These comparisons assume that energy rates will remain constant and supplies will be available when needed.

If we reduce the electric rate to $.032/KWHR, operating costs drop to $19.20 per hour. Break even for gas catalytic IR on a single-shift operation is 5.7 years, and on the two-shift operation it's 2.6 years, which are higher targets than most companies would accept, making the decision for the purchase of an electric system a favorable one. For a three-shift operation, the choice would most likely be the gas catalytic system. The gas convection oven, in this example, has higher acquisition costs than the other alternatives, and the operating costs are higher than the gas catalytic system.

Other considerations are that the electric IR and gas catalytic IR ovens do not need permits by the local authority for emissions. From this example, we can see how minor changes in numbers affects the final decision.

Summary

For the example given on Chart 2, if the customer had only 50 ft to install a system, part of the justification might include adding a new building to his plant, changing the bottom line result of the calculation. In the evaluation of any new equipment, whether it is infrared or other, a complete analysis will help guide you to make the correct decision within the goals and guidelines of your company. Each circumstance is different and each evaluation point may have different levels of importance for your company. §