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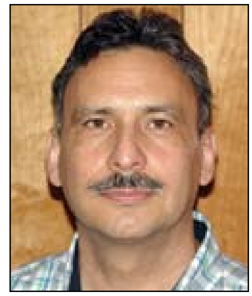

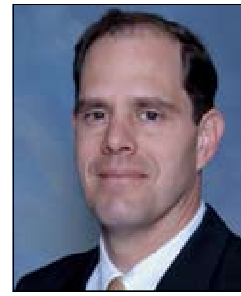

The Most Important Pump Calculation

How to Talk to Managers

Most financial decisions of any consequence at your facility are made by managers: plant managers, project managers, operations managers, financial managers, etc. To sell your ideas and technical recommendations to these decision makers, you must learn to talk to them in the financial language they understand.

The most common financial tools for evaluating investment options are net present value (NPV); payback; and internal rate of return (IRR). NPV, payback, and IRR are all acceptable financial measures to aid in the making of economic decisions. NPV returns a dollar value, payback returns a duration until investment is recouped, while IRR returns a rate of return value for the investment. All other factors, such as personal preferences and initial cost, should be secondary to these three financial parameters throughout the pump selection process. This article will address only NPV.

Table 1. Analysis of an air conditioning upgrade.

Year	Investment and Ongoing Cost of Ownership	Avoided Cost or Saving from the Investment
0	$8,000	
1		$3,400
2		$3,400
3		$3,400
4		$3,400
5		$3,400

A Simple NPV Example

Assume you are considering the purchase of a new air conditioning unit for $8,000. The seller of the unit predicts you will save about $200 per month due to the improvement in efficiency and estimates you'll save about $1,000 per year in maintenance for the next five years, resulting in a $3,400 per year saving or cost avoidance. This begs the question: does this investment make good economic sense?

To determine this, you must answer a few questions and make a few assumptions:

1. What is the project life? (5, 10, 20 years)
2. What is the rate of return that I can get for a zero risk investment in lieu of the purchase? (4 percent, 6 percent, 8 percent)
3. What is an acceptable NPV?

For this example, let's assume a 5 year project life, a 4 percent zero risk rate of return, and positive value for the NPV is an acceptable financial measure (see Table 1). The NPV in this example represents how much more (or less) you can expect to realize from your investment in present dollars.

This example was run on an Excel spreadsheet, using its NPV function, and arrived at a value for the NPV of $6,861. This result tells you that your $8,000 investment will earn $6,861 more than keeping the money in the bank earning 4 percent over the next five years. So, if you plan to stay in your home for more that 5 years, a new air conditioning unit makes good financial sense.

Generally, any option with a positive NPV is deemed acceptable, and the greater the NPV the better the option is. Because no one measure is conclusive, many companies place additional constraints on the decision, such as a payback of less than two or three years, to assure they are using their capital the most efficiently.

Pump Life Cycle Cost (LCC) Evaluations

When evaluating pump selections for your facility, you should use similar financial evaluations. However, industrial decision making includes additional factors, such as taxes, depreciation, spare part storage costs, etc. We call the cash flow analysis of the initial pump costs, energy costs, and maintenance costs the *life cycle cost analysis*.

This detailed economic evaluation, which typically returns the net present value of a pump under consideration, is the most important pump calculation you will ever make.

To properly evaluate a single or group of pumps, you need to know:

1. Cost of the pumps
2. Cost of installation
3. Annual energy costs
4. Annual cost of maintenance
5. Any other recurring cost
6. Discount rate (Risk Free Rate)
7. Project life
8. Corporate tax rate

A Real-World Pump Example

In Table 2, you will find the results of an analysis from the PumpCalcs.com expert calculator entitled, "Life Cycle Cost Analysis."

Upon inspection, you will see that Pump #1 has a lower purchase price, but requires more horsepower and is less reliable that Pump #2 (note that we assumed Pump #2 would have a 48-month mean time between repairs (MTBR) due to its superior design, as compared to the 24-month MTBR for Pump #1). Also included in this analysis is the effect of a more efficient motor on Pump #2.

To complete the analysis, you must compare the NPVs of these pumps. The pump with the least negative or most positive NPV should be considered the least costly pump to own over the project lifetime. We decided to use Paul Barringer's "Life Cycle Cost" worksheet to do these calculations, which can be downloaded free from http://www.barringer1.com/lcc.htm.

After downloading the worksheet, you must input the "Total Cost of the Installed Pump(s)" result from the expert calculator into Barringer's "Capital Acquisition Cost" cell and the "Total Annual Recurring Costs" result from the expert calculator into Barringer's "Annual Recurring Cost" cells from year 1 to year 20. (In this analysis, we selected a 20 year project life and a discount rate of 8 percent. We also chose to include a 3 percent inflation rate into the annual cost for realism.)

Once the data is entered, the worksheet returns an NVP of -$977,120. The negative sign indicates an outflow of money in the NPV equation. Excluding any revenue realized from the project, Pump #1 costs $977,120 (in today's dollars) to own for 20 years.

If we conduct a similar analysis for the Pump #2, we get an NPV of -$861,627. By comparing the results, we can clearly see that Pump #2 costs about $115,493 less to own than Pump #1 – in spite of the fact that Pump #1's purchase price is less that Pump #2, as seen in Table 3.

Table 2. Comparison of two centrifugal pumps.

	Pump #1	Pump #2
Application Facts		
Number of installed pumps	2	2
Number of pumps operating	1	1
% running time	96.0%	96.0%
Rated BHP (per pump)	200	180
Motor efficiency	92.5%	95.5%
KW's @ rated conditions	157.1	137.0
Baseline pump MTBF (months)	24	24
MTBF pump multiplier	1	2
Expected pump MTBF	24	48
Est. pump repair cost	$5,000	$5,000
Baseline motor MTBF (months)	72	72
MTBF motor multiplier	1	1.666
Expected motor MTBF	72	119.952
Est. motor repair cost	$3,000	$3,000
Cost of Operation		
Cost of energy ($/KWh)	$0.08	$0.08
Annual cost of energy	$108,516	$94,596
Annual cost of pump maintenance	$2,500	$1,250
Annual cost of motor maintenance	$500	$300
Total Annual Recurring Costs	**$111,516**	**$96,146**
Installation Cost		
Cost of each pump, motor, and base plate	$20,000	$22,000
Installation cost multiplier	3	3
Installation cost	$60,000	$66,000
Total Cost of Installed Pump(s)	**$160,000**	**$176,000**

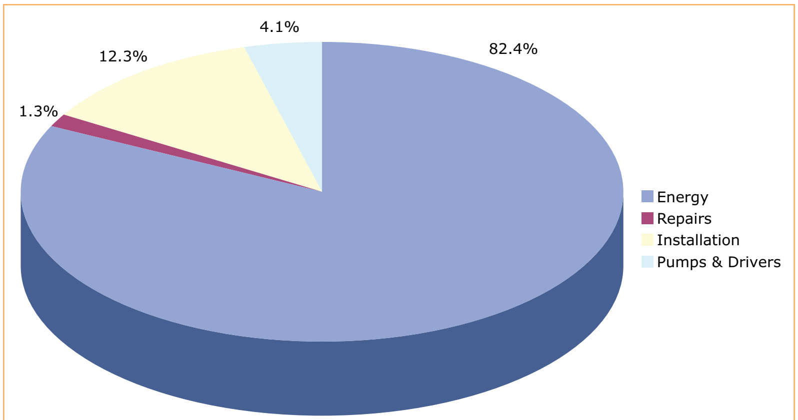

Figure 1. Breakdown of Pump #2 Life Cycle Costs

Breaking Down the Costs

Now let's look at the life cycle costs of Pump #2 in more detail. By rerunning the Barringer analysis to find the NPV numbers for pump costs, pump installation costs, energy costs, and repair costs separately, we can determine, on a percentage basis, the relative value of each component. A summary of Pump #2 can be found in Figure 1.

Notice that the most prominent cost of ownership is energy cost (82.4 percent), with the cost of installation coming in a distant second at 12.3 percent. You may be surprised to see that the cost of pumps represents only 4.1 percent of the total NPV, and pump repair costs only 1.3 percent of the NPV.

Closing Comments

The above results should come as no surprise, since energy costs traditionally dominate these types of calculations and the purchase price of the pumps

Table 3. Summary of NPV analysis.

Analysis Input	Pump #1	Pump #2	Difference
Capital Equipment	$160,000	$176,000	
Annual Expenses	$111,516	$96,146	
Project Life	20 years	20 years	
Inflation Rate	3%	3%	
NPV (Cost of Ownership)	-$977,120	-$861,627	$115,493

is usually a small part of the overall cost of ownership.

These are important conclusions for anyone that is new to the industry or for those who are focused solely on the technical aspect of pump selections and want to be more involved in financial decisions. Additionally, pump users should always be willing to pay a small premium for a higher efficiency pump and motor to reduce the largest cost over the pump's life.

Consider using the "Life Cycle Cost Analysis" expert calculator, along with Barringer's LCC worksheet, to evaluate pumps you are considering for future installations. These tools provide the best means of convincing your managers which pumps should be selected based on economic merit.

Remember the old slogan: "You can pay me now or you can pay me later."

P&S

Robert Perez, the website editor for PumpCalcs.com, has over 25 years of rotating equipment experience in the petrochemical industry, holds a BSME from Texas A&M University in College Station, a MSME degree from the University of Texas at Austin, a Texas PE license, and is an adjunct professor at Texas A&M University-Corpus Christi, teaching the Engineering Technology Rotating Equipment course. He can be reached at rxperez@pumpcalcs.com.

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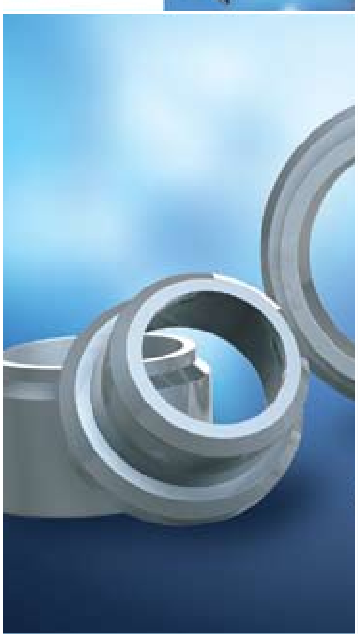

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