Refrigeration Systems Test with AC-XL

By: Chuck Fuller

Note: *AC-XL is the current brand name of the formula used in the test. The test was run under a previous brand but the formula is the same as the current ZEC Lubrication AC-XL product.*

I. INTRODUCTION

Significant savings in the annual power consumption of refrigeration systems that were treated with AC-XL were calculated using the data obtained from the Outback Steak House test conducted during December 2002 in Las Vegas, NV. The calculated decrease in energy consumption of the treated units, is due primarily to the increased efficiency of the heat exchangers. The annual energy efficiency increase, averaged over a 12 month period so as to include the highest and lowest monthly AC and refrigeration usage, was calculated to be 22.8%. This is consistent with other test results seen from the use of AC-XL.

II. TEST PROCEDURE

Preface

The evaluation included data obtained from a test conducted December 2002 at an Outback Steak House restaurant, in conjunction with additional data, obtained from a previous test (using identically sized equipment under similar operating conditions, excluding outside temperature) conducted in March of 2001 at a major hotel/casino also located in Las Vegas, Nevada. Used in combination, the Outback Steak House test (conducted during the winter) and the hotel/casino test (conducted during the spring), provide an accurate calculation of the expected annual energy efficiency increase. Annual energy efficiency increase is preferable to a single month, so that the effects of the treatment may be averaged out between hot and cold temperature months.

The compressor motors of the refrigeration units tested operate at a set horse power and have only two modes of operation; they are either on or off. The less time they are running the less power they consume. It must also be noted that since the heat exchange systems of the walk-in food chillers function by utilizing direct contact with the outside ambient temperature, has a direct correlation to the power consumption the walk-in food chillers. The correlation is as follows: the closer or further the outside ambient temperature is from the set point of the unit, the less or more time the compressor has to work in order to reach that set point, thereby lowering or raising the power consumption of the unit (set point being the temperature point, determined by the equipment operator; that once reached, causes the compressor of the unit to cycle off, requiring no further power consumption from the unit).

Simply put, the hotter or colder the outside temperature, the more or less the unit has to operate thereby using more or less power. An obvious point perhaps, but a significant one when you consider this: the longer a unit has to work to reach it's set point, the more energy efficient it can be made by the use of an oil additive. Conversely, the less time a unit operates, the less energy efficient the effect of the oil additive will be. Subsequently, an operator would be expected to receive less energy efficiency from his equipment during the cold months and significantly more efficiency during the warm months.

Procedure

Electronic meters that measure power consumption were installed and connected to the walk-in food chillers involved in the test. This installation was supervised and carried out by Fuller Instruments, Inc., a company with 25 years experience in sub-metering. Beginning on November 11th, baseline data for the power consumption of the walk-in food chillers (using 3-Ton compressors), was recorded for over two weeks in order to establish current operating data of the units. On November 28th the food chillers were treated. Electronic monitoring was continued for an additional ten days after introduction of AC-XL, with the test concluding on Dec 8th. The power consumption data was collected and analyzed by Fuller Instruments, Inc. to determine the effect of the treatment.

II. RESULTS SUMMARY

The food chillers were used on a consistent basis, giving us valid data that is sufficient to determine the efficiency of the AC-XL treatment for all of the units treated. As noted earlier, the annual energy efficiency increase is preferable to a single period increase. In order to calculate the energy efficiency increase as the outside temperature increases, the results of the AC-XL treatment (applied in identical food chiller units and environments) in the Outback Steak House test and the Hotel/Casino test, will be evaluated and correlated. Figure 1 shows the mathematical formula that explains and predicts this relationship. This formula can be used in order to calculate the energy efficiency increase of the treated units, in relation to the outside ambient temperature, even with infrequent runtime of the compressor.

Outback Steak House Test

To have a specific point of reference and since all the food chillers treated are identical in tonnage and usage, the specific data obtained on the chiller used for beer storage has been singled out for its data analysis. The beer chiller is a 3 Ton unit, circa 4-5 years old with a typical set point of 40º F. Since the test continued for ten days after the AC-XL treatment, the ten days prior to the treatment are being used as the comparison data in order to have a consistent outside temperature base (outside temperature averaged 50º F for the entire test period). Starting Nov. 19th, baseline data for the beer chiller, prior to the AC-XL treatment shows a total of 111.8 kWh consumption. Starting Nov. 28th, data for the beer chiller, after the AC-XL treatment shows a total of 108.5 kWh consumption. This is a reduction of 3% kWh consumption for the identical time use period.

While not a significant drop in overall kWh consumption, the averaged outside temperature (of 50ºF, for the entire testing period) is the deciding factor in the percentage of energy efficiency. This is because the beer chiller unit is operating very infrequently with the averaged daily temperature only 10º F above the set point of 40º F. This now provides an efficiency percentage figure of 3% that can be used to calculate the energy efficiency increase of the chiller as the outside temperature increases (see Figure 1).

Hotel/Casino Test

The Hotel/Casino test was conducted in March of 2001, in Las Vegas, NV. As with the beerchiller in the Outback test, the unit tested was a 3-Ton, circa 5 year old, walk-in food chiller using a typical set point of 40º F. The same testing procedure was used to evaluate the unit's performance; with a baseline of operation established and the before and after treatment data compared to evaluate the increased energy efficiency. The chiller unit recorded a 35% efficiency increase with the averaged outside temperature being 80º F, for the entire testing period. This significant increase is due to the chiller unit operating more frequently with the average daily temperature at 30º F above the set point of 40º F. This now provides an efficiency percentage figure of 35% that can be used to calculate the energy efficiency increase of the chiller as the outside temperature increases (see Figure 1).

III. TEST DATA & CONCLUSIONS

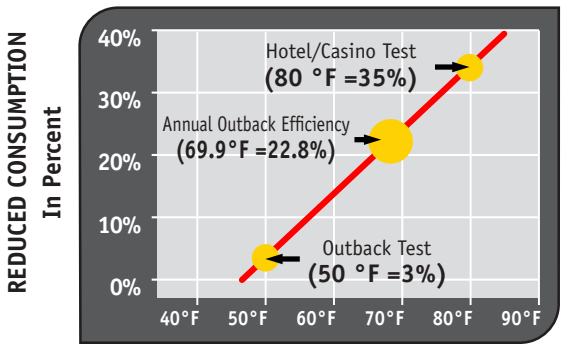
Correlation of Energy Efficiency to Temperature

Using the percentages obtained from the two tests involving the food chiller units, the efficiency percentage of either chiller (up to 40% -the highest known percentage attained in previous tests) can be obtained by plotting the ambient outside temperature on the graph in Figure 1. For example, if the outside temperature was 66° F, the resulting efficiency increase would be 20%.

(Figure 1.)

Correlation of Energy Efficiency to Temperature

*Knowing that the Outback Chiller experienced a reduced consumption of 3% (average temperature of 50 F) and that the Hotel/Casino chiller experienced a 35% reduction (average temperature of 80 F) (set points of both units being 40° F) the following graph and equation can be developed.



$$m = \frac{\triangle \text{ Reduced Consumption}}{\triangle \text{ Temperature}}$$

$$m = \frac{35-3}{80-50}$$

$$m = 1.067$$

f (x) = 1.067 * x -50.36

Interception of the y-axis is at -50.36

*Knowing that the energy consumption reduction on all known tests has never exceeded 40%, a limit of 40% has been placed on this formula regardless of temperature. A zero limit has also been put into effect because the product does not reduce efficiency

Monthly Temperature to Efficiency Ratio

Using the average monthly temperature for 2001 from the National Weather Service - LasVegas, averaged monthly efficiency can be calculated using the graph in Figure 1.

(Figure 2.)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Avr. Monthly Temp.	46.6 F	50.0 F	60.9 F	65.3 F	82.4 F	88.1 F	90.5 F	92.2 F	85.3 F	72.5 F	58.8 F	45.6 F
Avr. Efficiency %	0%	3%	14.6%	19.3%	37.6%	40%	40%	40%	40%	27%	12.4%	0%

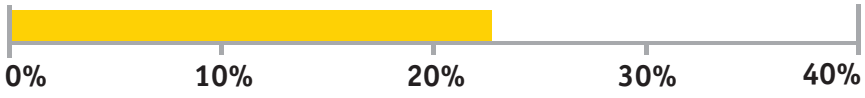
Total Annual Energy Efficiency Increase Average

Using the average monthly efficiency data from Figure 2, the total average efficiency for the entire year can be calculated as 22.8% . This is similar to the findings in past U.S.D.E. reports which averaged 21.2% efficiency out of 23 demonstrations, as well as other 3rd party tests performed using the AC-XL oil additive.

(Figure 3.)

Total Annual Energy Efficiency Increase Average

Key: - Increased efficiency over 12 months after AC-XL treatment= 22.8%



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