Applied Research Study Results

Aircosaver Technology

DURHAM COLLEGE OFFICE OF RESEARCH SERVICES AND INNOVATION

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Outcomes/Methods

Primary Outcomes/Methods - To determine the effectiveness of the Aircosaver's ability to reduce kWh consumption on commercial HVAC units.

Secondary Outcomes/Methods: Determine if there is an increase the number of compressor starts when the Aircosaver are applied to standard HVAC units.

Theoretical Principals

Air conditioning systems are sized to handle the most extreme of cooling demands. These demands occur only a few times during a cooling season, where as the rest of the season calls for "regular" demands. This means that the system operates predominately with an excess capacity. When a cooling cycle commences the compressor pushes cooling energy into a heat exchanger. This process acts as an energy storage device. This is when the system is operating at its highest efficiency. In standard conditions the storage is soon fully charged. At this point the compressor provides more cooling energy than the heat exchanger can facilitate. This is also known as thermodynamic saturation. To run your compressor during thermodynamic saturation simply put is a waste of overall energy. Aircosaver is a sensor-driven software algorithm designed to detect thermodynamic saturation and optimize the compressor accordingly. When overcapacity is detected, the Aircosaver switches the compressor off and avoids inefficient overcooling. Aircosaver technology allows the cooling unit to go into "saver mode", a process that keeps the fan running and the system utilizes maximum use of the cooling energy that has been stored in the heat exchanger. After the utilization of all stored energy, the compressor can effectively switch back on and run again. Set room temperatures can be reached without inefficient parts of the cooling cycle, resulting in significant energy savings without the possibility of losing overall cooling comfort. Each cooling unit is different and so too is weather conditions. The Aircosaver has the capability to adapt constantly to ensure efficient operations of your cooling system at all times. The research in theory will provide a better understanding of the benefits of the Aircosaver with regards to the overall reduction of current flow (kWh).

Methodology:

A controlled trail was implemented by measuring the baseline kWh consumption on 4 HAVC units atop the K-Wing at Durham College. Three o f the units were 7.5 ton and the 4th unit was a 10 ton.

Intellimeter data logger technology was installed on all 4 HVAC units July 9th to report all data in 5 minute increments for the duration of the monitoring phase which ended August 31st, 2010.

All thermostats in the K-wing were pre-programmed to standard temperatures.

The study occurred during the summer months when the lowest human movement would be occurring in the selected area of the College. Humidity and temperature sensors were placed in the 4 major areas that were served by the 4 HVAC units. All four distribution areas were very similar in cooling area dimension within 10 square feet.

July7th – July 27th represented the baseline data gathering time frame. The initial study guideline was to monitor the baseline for 14 days only, but due to installation challenges the Airco's were not installed on HVAC unit # 3 and 4 until July 27th. Resulting in 20 days of baseline data gathering.

July 27th – August 9th: Was the monitoring time period for the Airco application on units 3 and 4.

Results and Discussion.

Table 1.0

MEAN (kWh) per ton

Phase		Meter1 (control)	Meter2 (Control)	Meter3	Meter4
Base	Mean	.16799	.15060	.08036	.12721
	N	4573	4573	4573	4573
	Std. Deviation	.196797	.209205	.099806	.135240
Aircosaver	Mean	.12935	.09390	.03365	.03964
	N	3744	3744	3744	3744
	Std. Deviation	.172942	.176831	.089155	.108777

A total of **16,851** data points were collected over a 7 weeks period. From the data observed in Table 1.0, there is a statistically significant difference between the mean consumption of kWh's of each of the HVAC units. Each unit was brought to the level of kWh's per ton, to reflect a standardized measure between the units.

Levene's Test for Equality of Variances			t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Unit # 1	247.134	.000	9.403	8315	.000	.038638	.004109	.030583	.046693
			9.524	8273.465	.000	.038638	.004057	.030685	.046590
Unit # 2	415.275	.000	13.172	8315	.000	.056696	.004304	.048259	.065134
			13.392	8306.572	.000	.056696	.004233	.048398	.064995
Unit # 3	39.076	.000	3.200	8315	.001	.006712	.002097	.002601	.010823

			3.236	8252.111	.001	.006712	.002074	.002646	.010777
Unit # 4	329.705	.000	10.085	8315	.000	.027568	.002734	.022210	.032927
			10.303	8312.427	.000	.027568	.002676	.022323	.032813

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Meter1 (Control)	Between Groups	13.277	3	4.426	142.365	.000
	Within Groups	523.728	16847	.031		
	Total	537.006	16850			
Meter2 (Control)	Between Groups	21.808	3	7.269	227.900	.000
	Within Groups	537.366	16847	.032		
	Total	559.173	16850			
Meter3	Between Groups	4.926	3	1.642	366.267	.000
	Within Groups	75.520	16847	.004		
	Total	80.446	16850			
Meter4	Between Groups	2.128	3	.709	46.094	.000
	Within Groups	259.222	16847	.015		
	Total	261.349	16850			

Unit 1 and 2 were **less efficient at baseline than units 3 and 4 by 33%**. Keeping that in mind, we attached the Airco devices to Units 3 and 4 as they were the predetermined units at the planning stage of the study. The application of the Airco Saver units demonstrated a 66% change in energy consumption between the control units 1 and 2 and the experimental units 3 and 4. Adjusting the finding to reflect the standard efficiency difference at baseline reflects a total change from baseline of **33%**. Thus, the Airco demonstrated a **33% increase in energy efficiency** over the units (1 and 2) that did not have the Airco device attached.

There was a statistically significance difference noted between the units pre and post intervention with the Aircosaver . Retrofit energy efficiency technologies (Airco) in this study demonstrated significant impact P <.000, 95% confidence interval (.030583, 046693).

Please see table 2.0 that reflects these results.

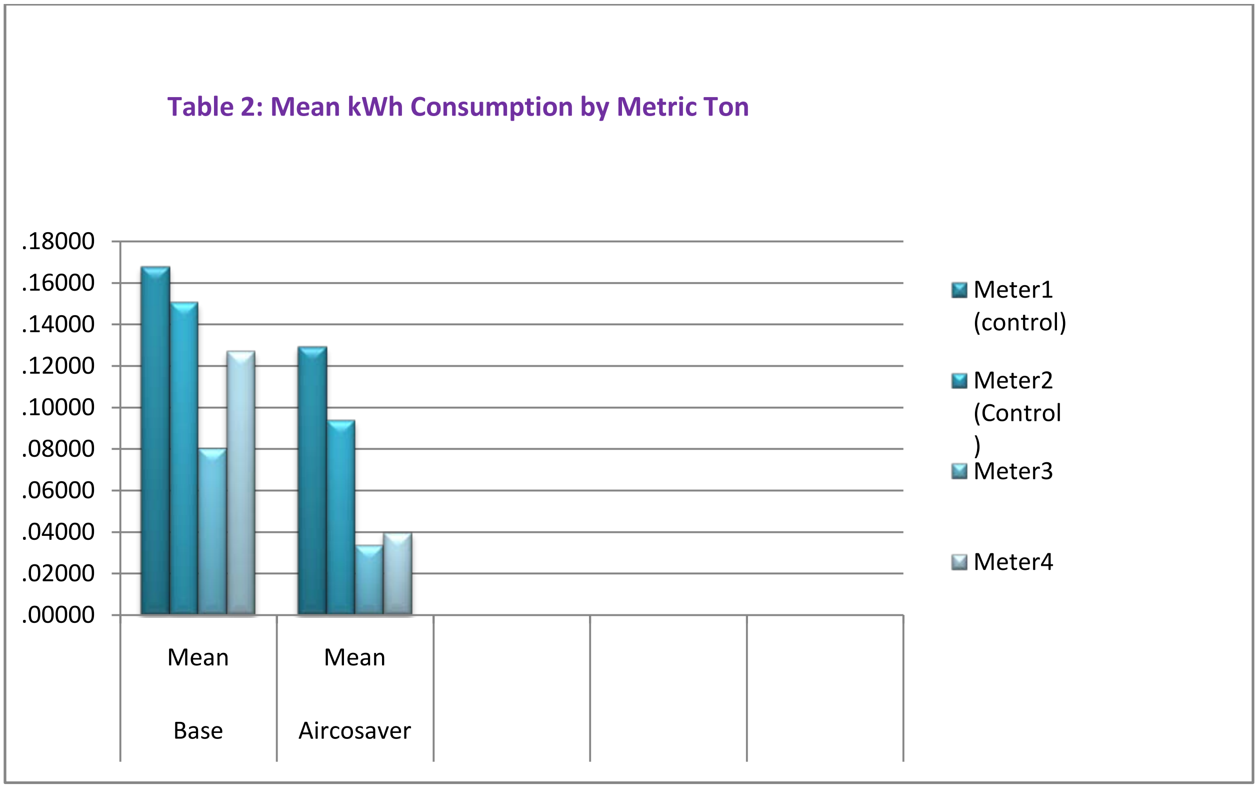
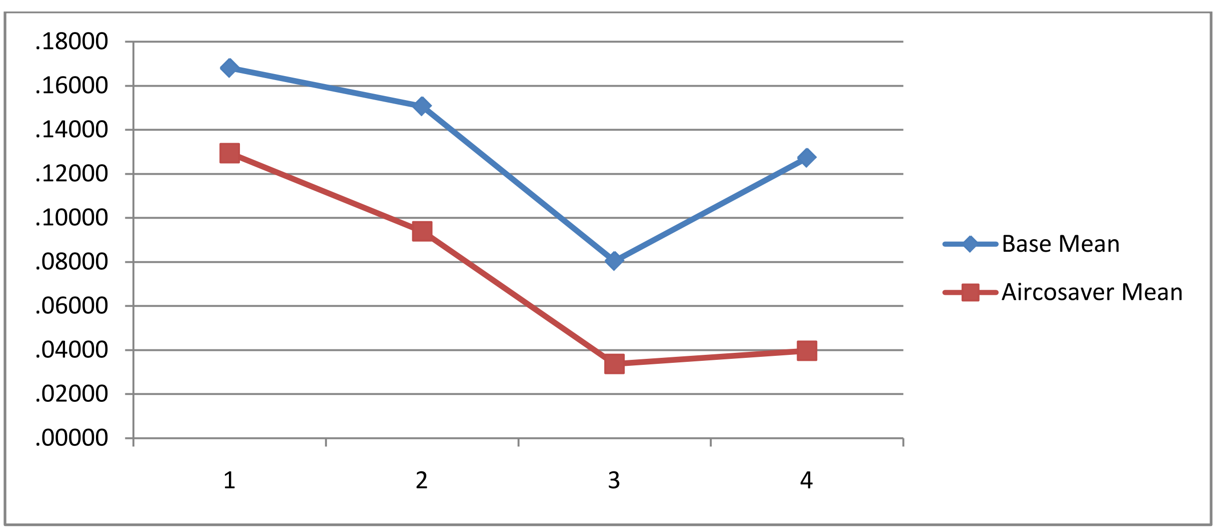


Table 3.0 : Mean energy consumption by application



A total of 31 days of monitoring of the four HVAC units using an Intellimeter monitoring system was completed. The average daily outdoor temperature during this period was 25.5 degrees Celsius and the average indoor set point temperature was 21 degrees Celsius. The average external relative humidity reading for the study period was 65%.

Finally, the secondary outcome for this study was to determine if the Aircosaver technology increased the number of compressor starts, thus potentially increasing the wear and tear on the compressor components versus the control units. The Airco unit was the only retrofit technology that offered reliable data to make this determination. The data did not suggest that the retrofit technology posed a significant difference in the number of "hard starts" on the experimental units in comparison to the control units, in fact the control units had on average 30% more hard starts, but that is also in keeping with the efficiency difference noted at baseline testing.

In conclusion, the Airco Saver showed an average increase in **energy efficiency of 33 %** over our control units.

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