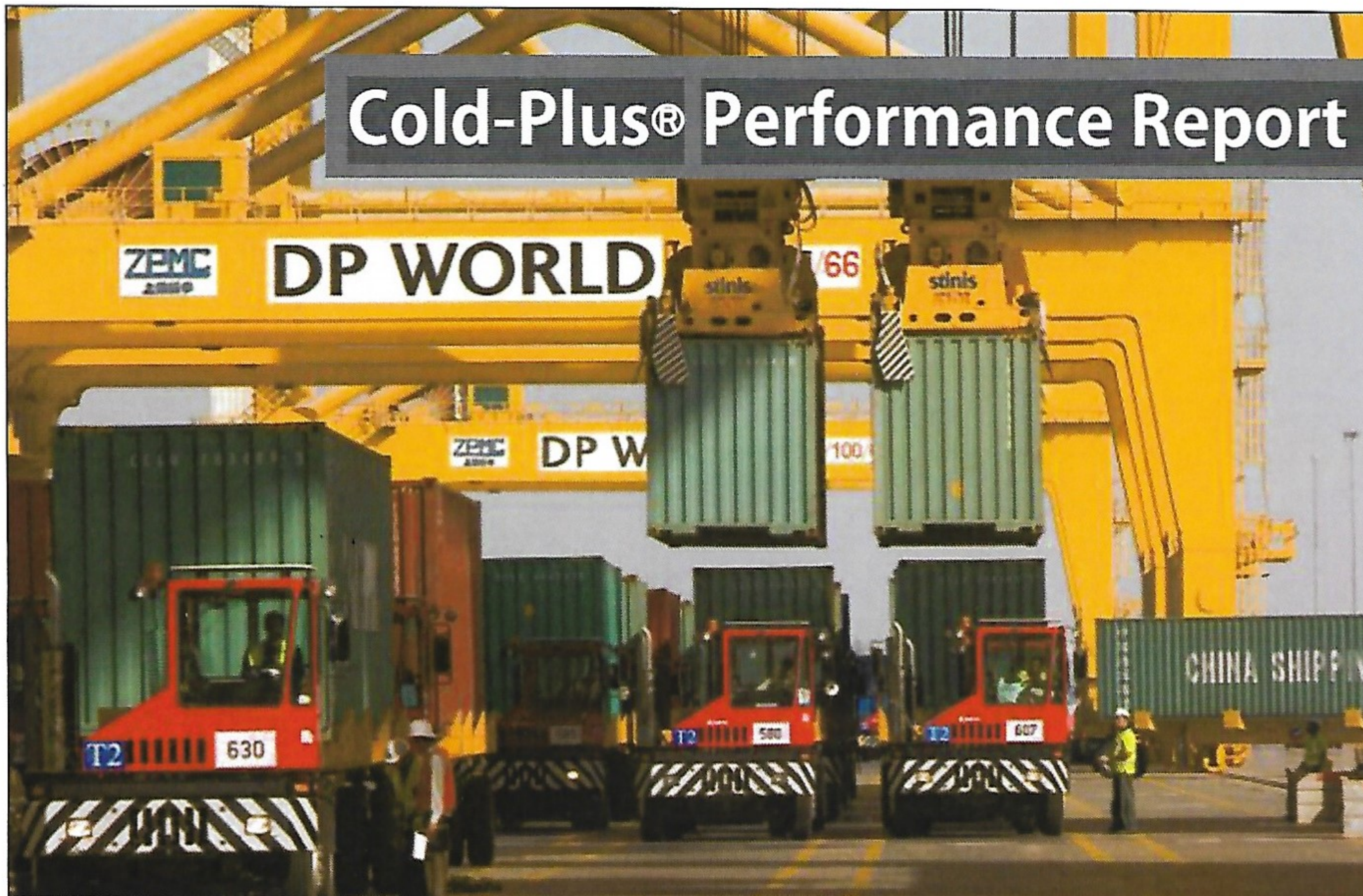
Cold-Plus® Performance Report



COLD-PLUS®

TESTING ANALYSIS AND REPORT OF FINDINGS

DP World, Refrigerated Warehouse; Dubai, UAE

January 17, 2017

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Cold-Plus® Testing Analysis and Report of Findings

DP World, Refrigerated Warehouse; Dubai, UAE

Data Collection: December 5, 2016 through December 27, 2016

Report date: January 17, 2017

Executive Summary

Under the direction and supervision of Professor Jenkins, Ph.D., PE, the following data was collected and analyzed from a cold storage warehouse supported by 5 Blitzer 6H-25.2 units located at the DP World Refrigerated Warehouse in Dubai, UAE. The data compares energy efficiency prior to, and after the injection of Cold-Plus®. Data was taken at one minute intervals for a period of 3 weeks and analyzed to measure the energy usage to keep the temperature constant in the room. For testing purposes, only three of the five Blitzer Units were running for the duration of the test. The other two units were taken out of service for the duration of this test. See Photo 1 showing the Blitzer Unit.

The data analysis concludes that there was a significant reduction of energy used per degree cooled in the system, with an energy reduction of 21.9% in the three units tested. This reduction in energy is a direct result of Cold-Plus®, which once injected caused a more efficient flow of the refrigerant and more efficient transfer of the cooling through the refrigeration system. This resulted in less compressor usage, particularly at peak periods, and supports the manufacturer's claim of significant energy savings and extension of life of the equipment after the injection of Cold-Plus®.

Analysis Review

Photo 1

The test protocol called for utilizing only 3 of the 5 compressors. These are defined as units 6, 7 and 9. The remaining two units remained off for the duration of the test. The protocol called for logging the following:

- Compressor amps
- Supply air (SA) temperature
- Supply air Relative Humidity percentage
- Return air (RA) Temperature
- Cold room temperature
- Temperature above cold curtain entrance
- Ambient air temperature.

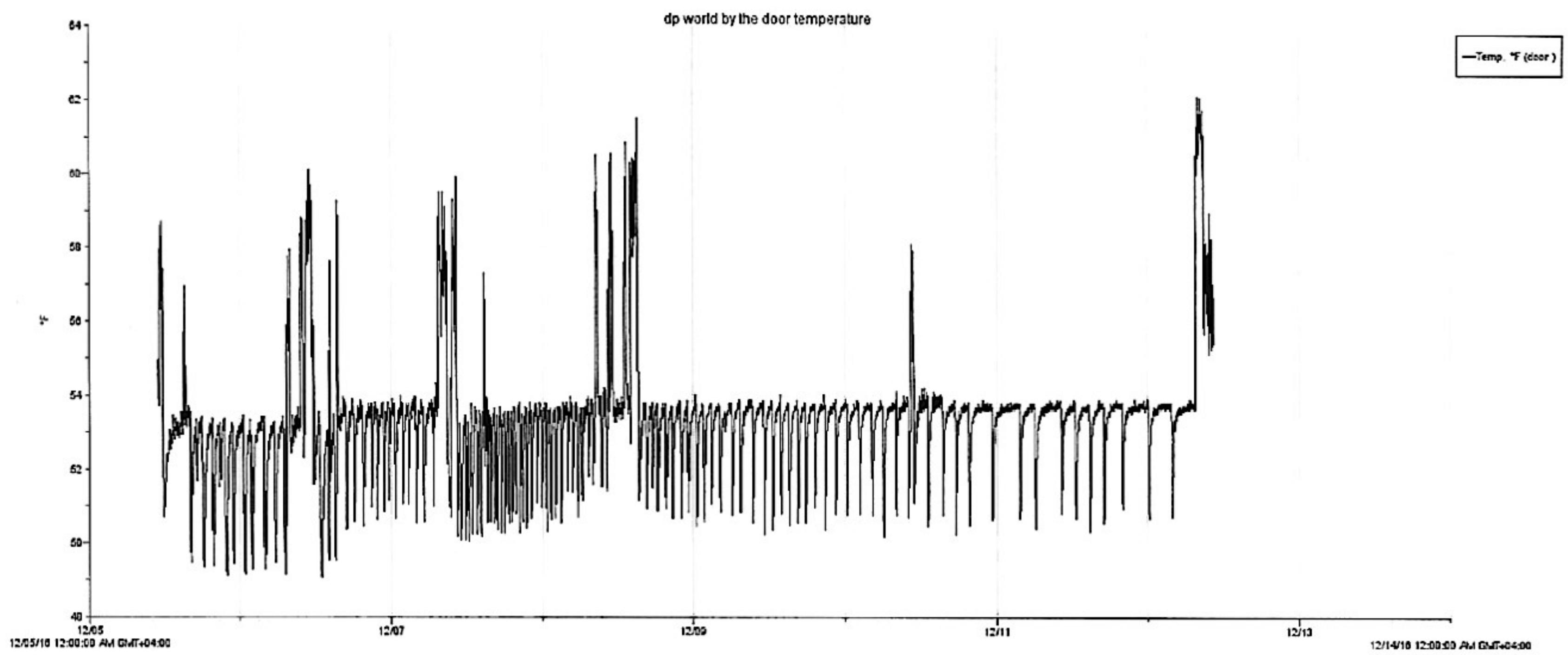
The test began December 5, 2016 and ended December 27, 2016. The methodology was:

- Utilize HOBO loggers to collect the information in three segments:
  - Obtain Baseline data for 7 days
  - Install Cold-Plus®
  - Operate the systems for approximately 7 days to allow the Cold-Plus® to complete installation
  - Obtain Post Injection data for an additional 7 days to log the results
- Utilize data from 24 hour periods when it is confirmed through the logging that the doors were not opened. Compare energy consumption on these days.

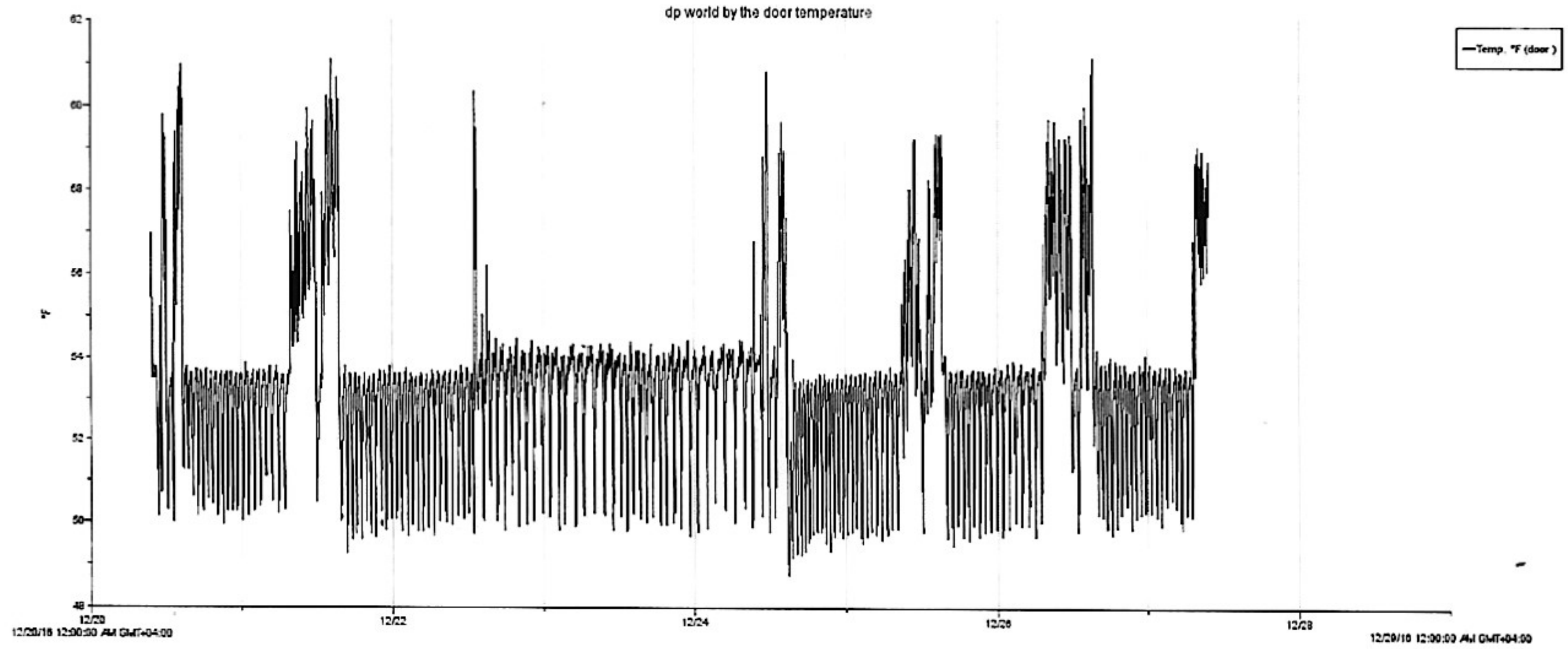
Data comparison is done determining the amps required to keep the room temperature constant while no door openings occurred. Comparing the values in the baseline with the last data period will give us the percent improvement in efficiency.

We used the temperature above the curtains to determine activity and heat introduction into the cold room.

The following is the baseline for the door temperature:



You can see that there are days with activity and days without activity during the baseline logging. Comparing this to the graph for after treatment we see the following:



You can see the activity in the post treatment (D4) is more intensive. Statistically the difference to base is:

	Cold Room Temp, °F	Door Temp °F	Door Open	Minutes Open	Avg Open Temp °F
Base: 12/5-12/12	50.57	53.35	7.0%	702.00	57.67
D4: 12/20-12/27	50.56	52.81	16.9%	1696.00	56.65
	0.00	0.53	-9.8%	-994.00	1.01

There is no difference in the cold room temperature, which indicates that the compressor activity is cooling the additional heat load from the door opening activity. The increase in door open time is 142% of the base number. Because of the random door openings, we made the side by side comparison based only on the days where no door activity occurred. That would use a 24-hour period on 12/09/2016 as the baseline and 12/23/2016 as the after (D4) comparison. This will eliminate the door opening variation completely and focus on compressor activity.

Analyzing the individual compressor activity for those days we see the following comparison:

Unit 6

	AC Curr, Amps	SA Temp, °F	RA Temp, °F	ΔT	Comp On	Minutes On	AmpsWf
Base: 12/9	4.94	48.10	50.54	2.43	33.6%	484.00	2392.55
D4: 12/23	4.25	48.93	50.38	1.45	28.7%	413.00	1753.53
	0.69	-0.83	0.16	0.99	4.9%	71.00	639.02

Unit 7

	AC Curr, Amps	SA Temp, °F	RA Temp, °F	ΔT	Comp On	Minutes On	Amps Wf
Base: 12/9	0.18	52.69	52.27	-0.42	0.6%	8.00	1.42
D4: 12/23	0.00	0.04	0.36	0.32	0.0%	0.00	0.00
	0.18	52.65	51.91	-0.74	0.6%	8.00	1.42

Unit 9

	AC Curr, Amps	SA Temp, °F	RA Temp, °F	ΔT	Comp On	Minutes On	AmpsWF
Base: 12/9	1.31	52.22	52.58	0.36	7.4%	107.00	140.65
D4: 12/23	1.62	52.33	52.73	0.40	9.7%	139.00	225.61
	-0.31	-0.11	-0.15	-0.04	-2.2%	-32.00	-84.96

Weighted Amps Baseline – 12/9		**Weighted Amps Post Injection 12/23**
Unit 6	2,392.55 Amps	1,753.53 Amps
Unit 7	1.42 Amps	0.00 Amps
Unit 9	140.65 Amps	225.61 Amps
Total	**2,534.62 Amps**	**1,979.14 Amps**

Combining all three units, the total amperage was reduced from 2,534 Amps Wf in the baseline period to 1,979 Amps Wf in the post injection period. **This is a reduction of 555.48 Amps Wf or 21.9%** used by the system to keep the room cooled to the same temperature.

Conclusions

This study concludes that a significant reduction of energy usage was achieved by the injection of Cold-Plus® into the (3) Blitzer 6H-25.2 compressors. The compressors used less amperage while running and, more importantly, they ran for fewer minutes. **This will result in 21.9% less electrical consumption**. The 21.9% reduction in energy consumption should also lead to a **significantly increased life of the equipment as a result of the compressors running less intensely and for fewer minutes to maintain the desired temperature**.

Professor Peter E. Jenkins, Ph.D., PE
CV attached

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Summary

Extensive experience serving in administrative and management positions in both industry and academic institutions. Served as an officer of the University of Colorado Denver and of an advanced technology and manufacturing company with experience in administration, strategic and financial planning. Experience as senior contract officer dealing with U.S. and foreign industrial and government agencies. Academic and industry experience includes serving as Dean, Department Chair, Associate Department Chair, Executive Vice President, Chief Operating Officer, and Director of Engineering.

Successful experience dealing with government and industry institutions and have had success working and obtaining support from both political and industrial agencies. Enjoy outreach programs and working with the industrial and state political systems to obtain program support. Have extensive experience working with industry and government agencies to develop partnerships for technology transfer and for developing R&D programs.

Education

Ph.D. Purdue University, W. Lafayette, IN, 1974
M.S. Southern Methodist University, Dallas, TX, 1969
B.S. University of Kansas, Lawrence, KS, 1965
I.E.M. Harvard University, Cambridge, MA, 1994
M.B.A. Pepperdine University, Malibu, CA, 1986

Military Experience

United States Marine Corps: 1958-1963

Academic Experience

United States Naval Academy, Annapolis, ME

- Visiting Professor, Mechanical Engineering Dept, July, 2007- August, 2008
- Director, ONR Fuels Research Group

United States Air Force Academy, Colorado Springs, CO

- Distinguished Visiting Professor, Engineering Mechanics Dept., July 2004-May, 2006
- Director, Energy Research Center
- Member of UAV Research Program