TEST REPORT No.59

Date: 30 September 2020

CHILLER EFFICIENCY PERFORMANCE WITH INTELLIGENT ADIABATIC CHILLER-BOOSTING **SMART COOLING™** PRO 10 SYSTEM

Test Participants

Customer: Saudi Arabian Oil Company

Contractor: KASAB International Energy Services

Installer: KASAB International Energy Services

Swiss Integrated Energy Technologies: Luca Gallarate

Project name: Adiabatic pre-cooling **Smart Cooling™** PRO 10 system

Structure location: Saudi Aramco SGPD Udhailiyah

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Introduction

Type of structure: Office building.

Cooling equipment: Zamill ARX 140A chiller with four Bitzer piston-type compressors.

Cooling capacity as per manufacturer's data performance sheet: 555 kW

Electricity consumption as per manufacturer's data performance sheet: 194 kW

Chiller booster: **Smart Cooling**™ PRO 10 – adiabatic technology with condenser protection.

Test target:

Collect data about chiller efficiency using “Smart Cooling” PRO10 device.

Main components

Smart Cooling™ PRO 10 comprises the following key components: condenser protective membranes, water treatment and recirculation systems, high-pressure water pumps, control unit, high-pressure nozzle panels, fasteners and fixings, temperature and humidity sensors current sensors.

Protective membranes are installed outside the condenser and cover its entire surface, preventing water mist from coming into direct contact with the condenser.

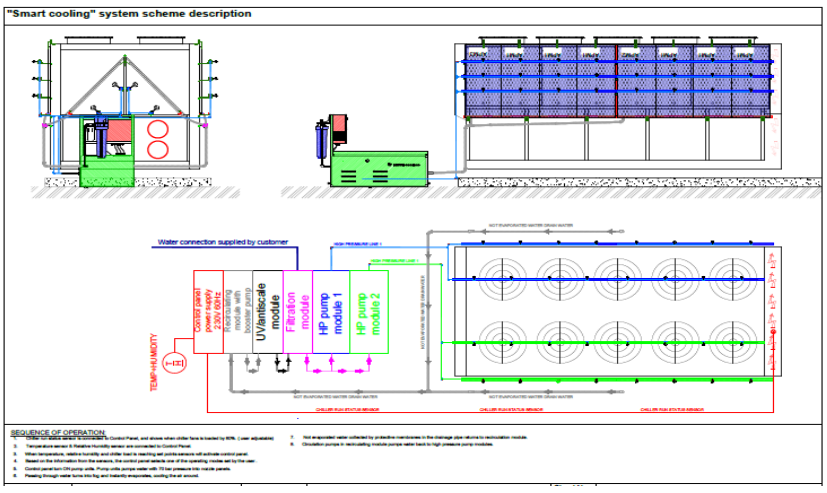
Water filtration, purification and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.

A high-pressure pump provides water pressure of up to 70 bar while a water recirculation system reintroduces non-evaporated water into the water purification and pump system.

The control unit regulates the system according to real-time data sets such as chiller parameters, ambient air temperature and humidity to supply the adiabatic system with the appropriate amount of water.

A high-pressure nozzle provides water spray with 5- to 40-micron droplets.

A set of fasteners and fixings ensure the compatibility of the equipment with the chiller.



Equipment sample: Zamill ARX 140A chillers.

Measuring instruments

An RIF600 ultrasonic waterflow meter was used to measure chiller effectiveness and a Fluke energy monitoring equipment was used to measure electricity consumption.

Recommendations

Condenser coil cleaning should be based on condition monitoring rather than a fixed preventive maintenance cycle. Chiller booster more effective when chiller load reaches over 50% and more than one compressor is loaded.

Evaluation – originally proposed methodology

The **Smart Cooling**™ PRO 10 system offers full operational control and can be switched on or off when necessary.

It was our expectation to conduct a “day on/day off” test over an extended period to establish the equipment performance with greater accuracy.

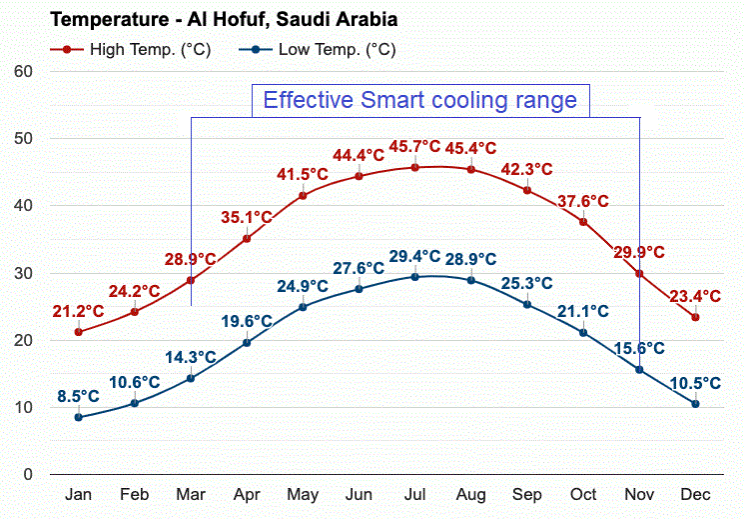
A notable improvement in chiller performance would be one of the effects of the **Smart Cooling**™ PRO 10 system over the chiller and observable in data sets of electricity input *against* cooling output.

It was therefore suggested that “day on/day off” testing be undertaken to record:

1. Chiller electricity consumption
2. Chiller cooling output
3. Hourly external dry-bulb air temperature hourly external relative humidity

The suggested duration of the testing regime was six weeks; with the potential of yielding the greatest number of readings on each condition.

Two regression models of electricity consumption would then be created – representing the “on” and “off” conditions, respectively – with chiller cooling output and cooling degree-day values as independent variables.

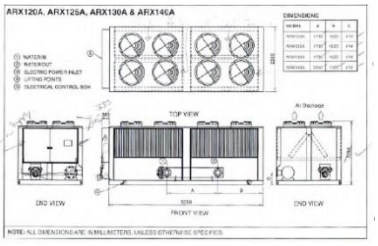


Cooling degree days would be derived from dry-bulb temperatures, with the relative humidity readings held in reserve in case it was proven necessary to develop an enthalpy-based model.

Effective savings would be inferred from the difference between the two regression models and annual expected savings extrapolated from them.

On-site observation

Chiller model: Zamill ARX 140A with R22 gas, with four Bitzer 6F-50.2-40 piston-type compressors



ELECTRICAL DATA

UNIT SIZE	SUPPLY VOLTAGE					COMPRESSOR TYPE-1							COMPRESSOR TYPE-2							CONDENSER FAN MOTORS				
	Nominal (V-Ph-Hz)	Min.	Max.	MCA	MOCP	Qty.	RLA (each)	LRA (each)	CB Poles	CB1 MTA	CB1 Qty.	CB2 MTA	CB2 Qty.	Qty.	RLA (each)	LRA (each)	CB Poles	CB1 MTA	CB1 Qty.	CB2 MTA	CB2 Qty.	Qty. (3 ph)	FLA (each)	Total kW	FCA	CB Qty.
ARX110A	208/230-3-60	187	253	602	853	2	251	1100	3	241	2	161	2	-	-	-	3	-	-	-	-	8	4.4	10.4	35.2	4
	380-3-60	342	418	332	470	2	138	650	3	132	2	88	2	-	-	-	3	-	-	-	-	8	2.5	10.4	20	4
	460-3-60	414	506	280	394	2	114.7	520	3	110	2	73	2	-	-	-	3	-	-	-	-	8	2.5	11.6	20	4
ARX120A	208/230-3-60	187	253	490	591	4	101.2	337	3	76	8	+	-	-	-	-	3	-	-	-	-	8	7.2	16.8	57.6	4
	380-3-60	342	418	296	358	4	62.3	187	3	47	8	+	-	-	-	-	3	-	-	-	-	8	3.6	15.36	28.8	4
	460-3-60	414	506	242	293	4	50.6	147	3	38	8	+	-	-	-	-	3	-	-	-	-	8	3.1	15.36	24.8	4
ARX125A	208/230-3-60	187	253	539	661	2	122.7	412	3	92	4	-	-	2	101	337	3	76	4	-	-	8	7.2	16.8	57.6	4
	380-3-60	342	418	326	401	2	75.5	229	3	57	4	+	-	2	62	187	3	47	4	-	-	8	3.6	15.36	28.8	4
	460-3-60	414	506	266	326	2	61.3	180	3	46	4	+	+	2	51	147	3	38	4	-	-	8	3.1	15.36	24.8	4
ARX130A	208/230-3-60	187	253	582	704	4	122.7	412	3	92	8	-	-	-	-	-	3	-	-	-	-	8	7.2	16.8	57.6	4
	380-3-60	342	418	352	429	4	75.5	229	3	57	8	+	-	-	-	-	3	-	-	-	-	8	3.6	15.36	28.8	4
	460-3-60	414	506	288	349	4	61.3	180	3	46	8	+	+	-	-	-	3	-	-	-	-	8	3.1	15.36	24.8	4
ARX140A	208/230-3-60	187	253	685	810	2	155.2	452	3	116	4	-	-	2	123	412	3	92	4	-	-	8	7.2	16.8	57.6	4
	380-3-60	342	418	397	493	2	95.6	259	3	72	4	-	-	2	76	259	3	57	4	-	-	8	3.6	15.36	28.8	4
	460-3-60	414	506	325	402	2	77.7	226	3	58	4	+	+	2	61	180	3	46	4	-	+	8	3.1	15.36	24.8	4
ARX160A	208/230-3-60	187	253	844	1045	4	201	945	3	161	4	129	4	+	-	-	3	-	-	-	-	12	7.2	25.2	86.4	6
	380-3-60	342	418	514	624	4	110	514	3	106	4	70	4	-	-	-	3	-	-	-	-	12	3.6	23.04	43.2	6
	460-3-60	414	506	432	524	4	92	381	3	88	4	59	4	-	-	-	3	-	-	-	-	12	3.1	23.04	37.2	6
ARX170A	208/230-3-60	187	253	600	830	2	155.2	452	3	116	4	+	+	2	123	412	3	92	4	-	-	12	7.2	25.2	86.4	6
	380-3-60	342	418	412	507	2	95.6	259	3	72	4	-	-	2	76	259	3	57	4	-	-	12	3.6	23.04	43.2	6
	460-3-60	414	506	337	415	2	77.7	226	3	58	4	-	-	2	61	180	3	46	4	-	-	12	3.1	23.04	37.2	6

The Zamill ARX 140A chiller data sheet shows how different external ambient air temperatures affect the chiller's electricity consumption.

PERFORMANCE DATA (Metric units)

LEAVING CHILLED WATER TEMP. (LCWT)	UNIT SIZE	35°C AMBIENT TEMPERATURE				40°C AMBIENT TEMPERATURE				46°C AMBIENT TEMPERATURE				52°C AMBIENT TEMPERATURE			
		CAP. (kW)	COMP. kW	COP	WATER FLOW (LPS)	CAP. (kW)	COMP. kW	COP	WATER FLOW (LPS)	CAP. (kW)	COMP. kW	COP	WATER FLOW (LPS)	CAP. (kW)	COMP. kW	COP	WATER FLOW (LPS)
10 °C	ARX 010A	41.4	12.3	3.0	1.7	39.3	13.3	2.7	1.6	36.8	14.3	2.4	1.5	34.3	15.3	2.1	1.4
	ARX 012A	47.6	15.3	2.9	1.9	45.3	16.3	2.6	1.8	42.5	17.5	2.3	1.7	39.7	18.5	2.0	1.6
	ARX 015A	57.0	19.1	2.8	2.3	54.1	20.4	2.5	2.2	50.8	22.0	2.2	2.0	47.5	23.6	1.9	1.9
	ARX 020A	74.3	22.8	3.0	3.0	70.8	24.5	2.7	2.8	66.6	26.8	2.3	2.7	62.3	29.4	2.0	2.5
	ARX 022A	85.4	27.6	2.9	3.4	81.4	29.8	2.6	3.2	76.6	32.7	2.2	3.1	71.8	36.0	1.9	2.9
	ARX 025A	94.8	31.0	2.9	3.8	90.2	33.3	2.6	3.6	84.8	36.5	2.2	3.4	79.3	40.1	1.9	3.2
	ARX 030A	112.2	35.3	2.9	4.5	106.7	38.0	2.6	4.3	100.1	41.7	2.2	4.0	93.3	45.9	1.9	3.7
	ARX 035A	127.6	42.5	2.8	5.1	121.5	45.8	2.5	4.8	114.3	50.3	2.1	4.6	107.1	55.4	1.8	4.3
	ARX 040A	155.6	44.1	3.2	6.2	148.4	47.4	2.8	5.9	139.7	51.8	2.4	5.6	131.0	56.9	2.1	5.2
	ARX 050A	200.8	59.5	3.1	8.0	191.4	64.1	2.8	7.6	180.1	70.3	2.4	7.2	168.8	77.3	2.0	6.7
	ARX 060A	230.5	67.9	3.0	9.2	219.7	73.1	2.7	8.8	206.4	80.2	2.3	8.2	193.2	88.4	2.0	7.7
	ARX 070A	265.0	81.7	3.0	10.6	252.9	88.2	2.6	10.1	238.5	97.1	2.3	9.5	224.1	107.1	2.0	8.9
	ARX 080A	304.7	100.8	2.7	12.1	290.1	106.9	2.5	11.6	273.3	114.2	2.2	10.9	257.4	121.1	2.0	10.3
	ARX 090A	334.5	111.7	2.7	13.3	318.4	118.5	2.5	12.7	299.9	126.5	2.2	12.0	282.1	134.3	1.9	11.2
	ARX 100A	369.2	117.6	2.9	14.7	351.5	125.0	2.6	14.0	331.0	133.9	2.3	13.2	311.2	142.7	2.0	12.4
	ARX 110A	419.1	142.1	2.7	16.7	397.8	150.1	2.5	15.9	372.4	159.1	2.2	14.8	347.3	167.6	2.0	13.8
	ARX 120A	455.7	137.3	3.0	18.2	433.9	147.8	2.6	17.3	407.5	162.2	2.3	16.2	380.7	178.6	1.9	15.2
	ARX 125A	485.1	150.4	2.9	19.3	462.2	162.0	2.6	18.4	434.8	177.9	2.2	17.3	407.2	195.8	1.9	16.2
	ARX 130A	513.8	163.5	2.9	20.5	490.0	176.3	2.5	19.5	461.5	193.6	2.2	18.4	433.2	213.0	1.9	17.3
	ARX 140A	555.9	184.8	2.8	22.2	530.5	198.3	2.5	21.2	500.2	216.4	2.1	19.9	470.0	236.5	1.9	18.7
	ARX 160A	621.5	196.2	2.8	24.8	591.7	208.8	2.5	23.6	557.3	223.5	2.2	22.2	524.5	237.7	2.0	20.9
	ARX 170A	664.4	218.7	2.7	26.5	632.8	232.2	2.5	25.2	596.2	248.2	2.2	23.8	561.1	263.9	1.9	22.4

Results

Viable data obtained from continual operation started to be collected on 14 July 2020 and the test was terminated on 7 September 2020.

During this period, it was possible to witness four "on" and "off" periods and, to our satisfaction, from that observation a clear picture emerged.

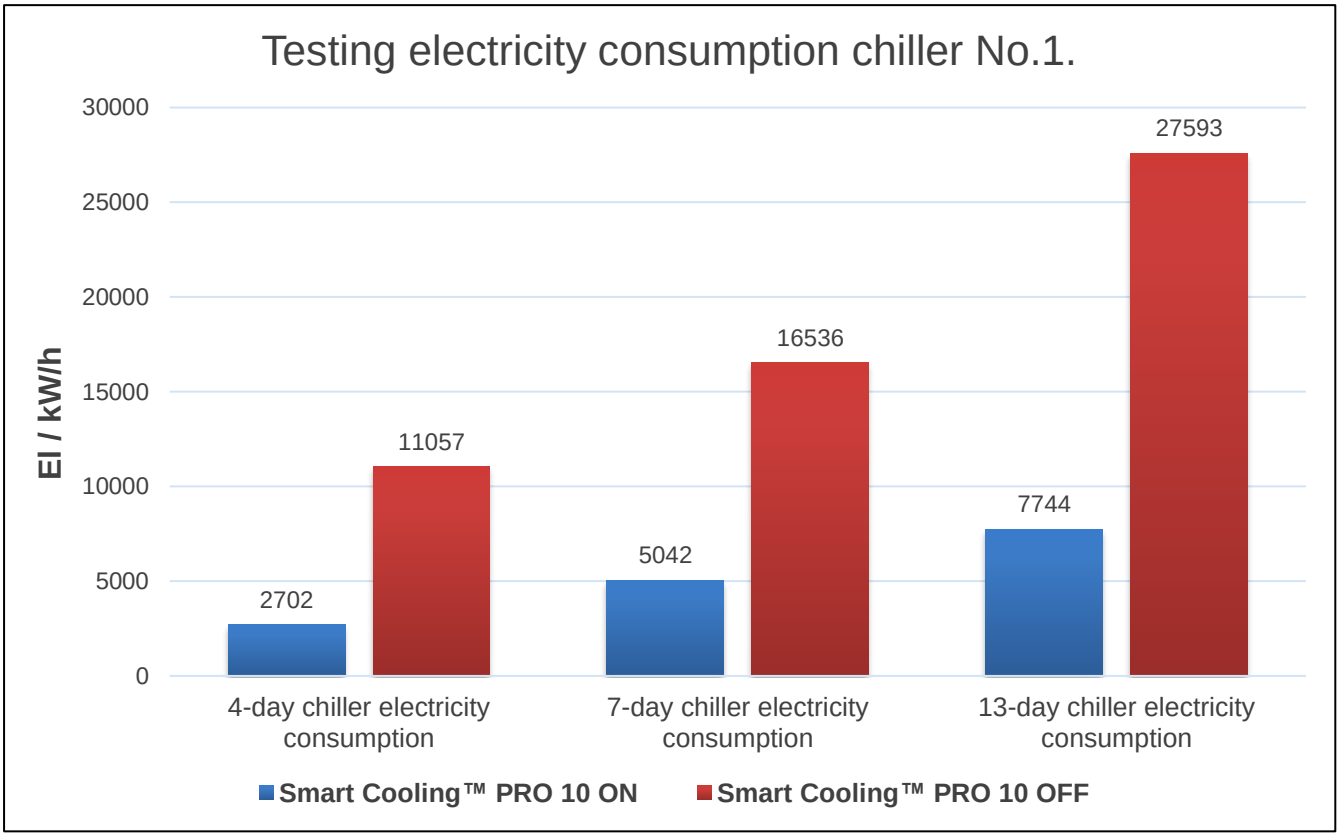
Data on chiller electricity consumption and cooling output were collected at 30 minute-intervals and separated into three distinct sets. One set took place during intervals when **Smart Cooling**™ PRO 10 had been in operation and the other two sets in periods when it had been disabled.

A regression model was then built for each condition.Comparison of the "on" and "off" regression models shows that **Smart Cooling**™ PRO 10 did have a beneficial effect.

Testing procedures

Testing conducted on chiller No.1.

SC status	Time	4 days	El/ kW/h
OFF	14.07.2020 – 19.07.2020	4-day chiller electricity consumption with **Smart Cooling™** OFF	11057
ON	14.07.2020 – 19.07.2020	4-day chiller electricity consumption with **Smart Cooling™** ON	2702
SC status	**Time**	**7 days**	**El/ kW/h**
OFF	19.07.2020 - 26.07.2020	7-day chiller electricity consumption with **Smart Cooling™** OFF	16536
ON	25.08.2020 - 01.09.2020	7-day chiller electricity consumption with **Smart Cooling™** ON	5042
SC status	**Time**	**13 days**	**El/ kW/h**
OFF	19.07.2020 - 26.07.2020	13-day chiller electricity consumption with **Smart Cooling™** OFF	27593
ON	25.08.2020 - 01.09.2020	13-day chiller electricity consumption with **Smart Cooling™** ON	7744



Test No.1 (Chiller electricity energy test)

4 Days Off / 4 Days On – Smart Cooling™ PRO 10 **Comparison**

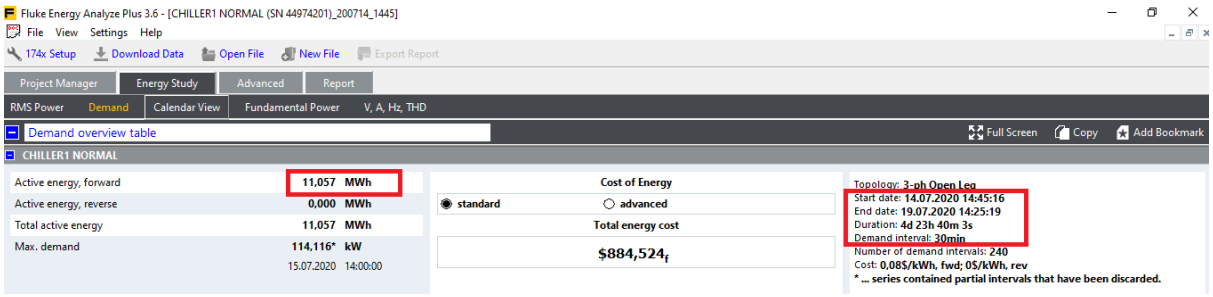
Smart Cooling™ PRO 10 OFF – 14.07.2020 to 19.07.2020

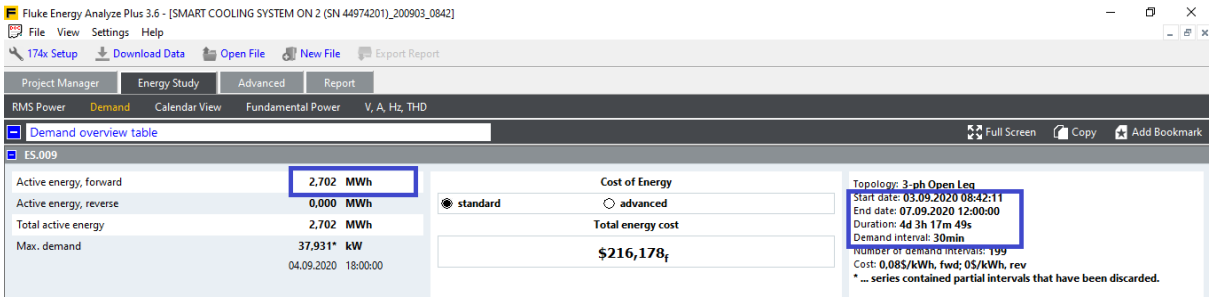
VS

Smart Cooling™ PRO 10 ON – 03.09.2020 to 07.09.2020

Test Nr. 1 Chiller electricity consumption 4 days without "Smart Cooling" adiabatic chiller booster system											
Status adiabatic system	Nr.	DATE	HOURS USED	DATA SHEET CHILLER ENERGY CONSUMPTION (kW/h) 100% load	CHILLER ENERGY CONSUMPTION (KW) TEST TIME 7 days	CHILLER ENERGY CONSUMPTION (KW/h) AVAREGE 1 hour	CHILLER ENERGY CONSUMPTION (KW h) test time per da1 day	COOLING CAPACITY DATA SHEET (kw/h) 100% cooling load	COP AVARAGE Data sheet 35 C	COP AVARAGE TEST IME	Chiller data sheet WATER FLOW RATE (m3/h)
OFF	1	14.07.2020 - 19.07.2020	119	164	11057	92,92	2764,25		2,40	1,2	40
				Water T 10C air T 35C				555			

Test Nr. 1 Chiller electricity consumption 4 days with "Smart Cooling" adiabatic chiller booster system											
Status adiabatic system	Nr.	DATE	HOURS USED	DATA SHEET CHILLER ENERGY CONSUMPTION (kW/h) 100% load	CHILLER ENERGY CONSUMPTION (KW) TEST TIME 7 days	CHILLER ENERGY CONSUMPTION (KW/h) AVAREGE 1 hour	CHILLER ENERGY CONSUMPTION (KW h)test time per da1 day	COOLING CAPACITY DATA SHEET (kw/h) 100% cooling load	COP AVARAGE Data sheet 35 C	COP AVARAGE TEST IME	Chiller data sheet WATER FLOW RATE (m3/h)
ON	1	03.09.2020 - 07.09.2020	99	164	2702	27 - 50	675,5		2,40		40
				Water T 10C air T 35C				555			





Test Nr. 1 – Fluke energy monitoring system shows that when operating for **four days** with **Smart Cooling™** PRO 10 turned off, the chiller's average electricity consumption was **11057 kw/h.**

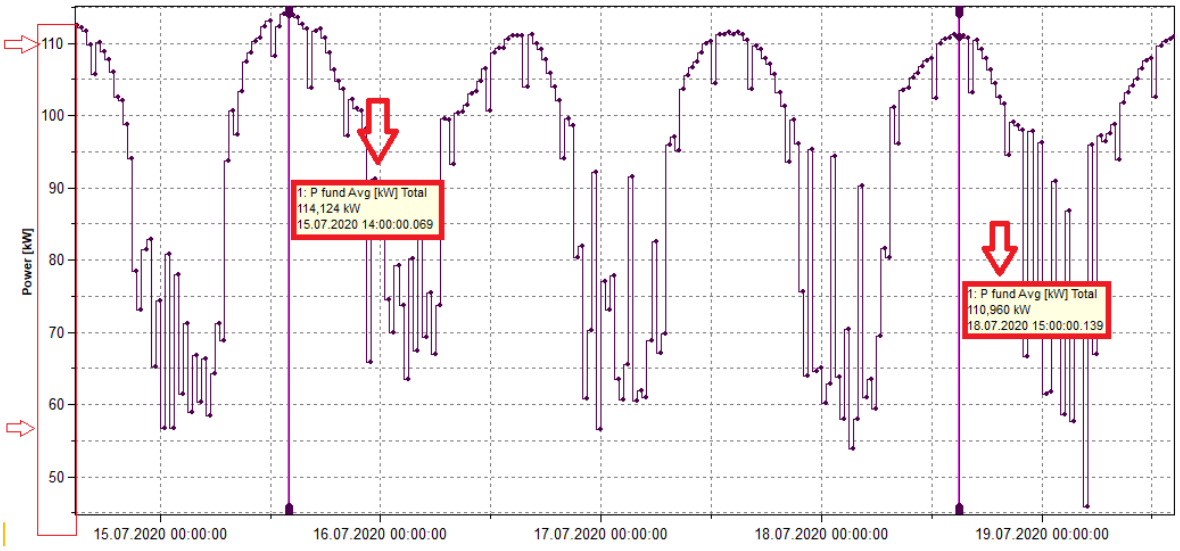
When working for **four days** with **Smart Cooling™** PRO 10 turned on, electricity consumption was **2702 kw/h.**

Average chiller electricity savings in four days was 1336,8 SAR (8355 kw/h x 0,16 SAR)

Water consumption in four days amounted to 11.04 m3 x 6 SAR = 66,24 SAR

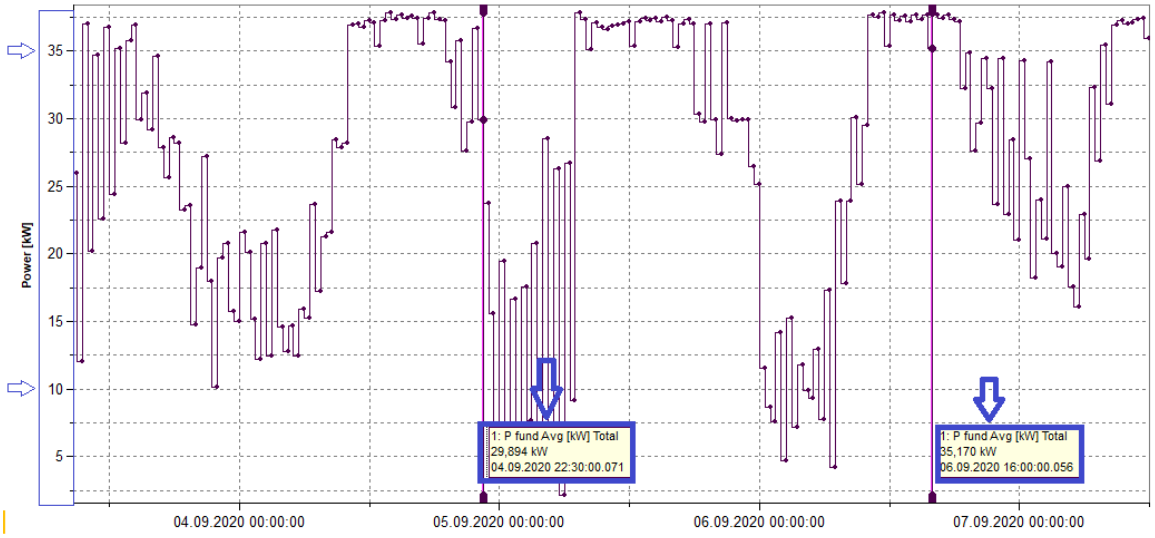
The Fluke energy monitoring system indicated electricity consumption of **90 kw/h – 114 kw/h** with **Smart Cooling™** PRO 10 turned **OFF.**

Fluke energy meter readings



Fluke energy monitoring system Fluke indicated electricity consumption of **27 kw/h – 50 kw/h** with **Smart Cooling™** PRO 10 turned **ON.**

Fluke energy meter readings



Test No.2. (Chiller electricity energy test)

7 Days Off / 7 Days On – Smart Cooling™ PRO 10 Comparison

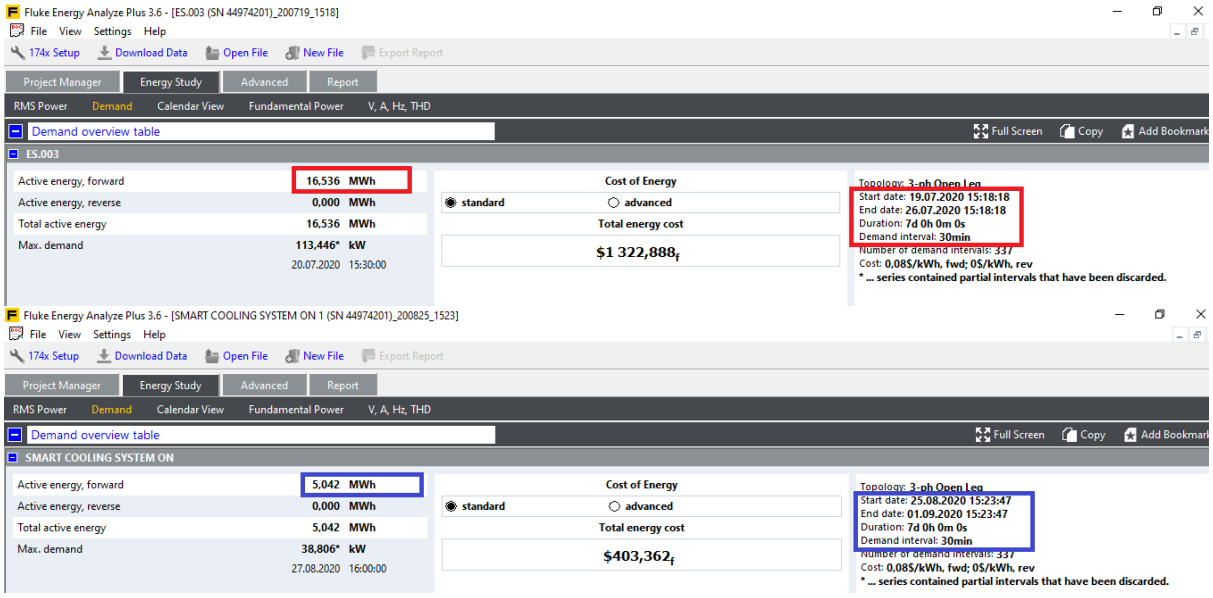
Smart Cooling™ PRO 10 OFF – 19.07.2020 to 26.07.2020

VS

Smart Cooling™ PRO 10 ON – 03.09.2020 – 07.09.2020

Test Nr. 1 Chiller electricity consumption without "Smart Cooling" adiabatic chiller booster system											
Status adiabatic system	Nr.	DATE	HOURS USED	DATA SHEET CHILLER ENERGY CONSUMPTION (kW/h) 100% load	CHILLER ENERGY CONSUMPTION (KW) TEST TIME 7 days	CHILLER ENERGY CONSUMPTION (KW/h) AVAREGE 1 hour	CHILLER ENERGY CONSUMPTION (KW h)test time per da1 day	COOLING CAPACITY DATA SHEET (kw/h) 100% cooling load	COP AVARAGE Data sheet 35 C	COP AVARAGE TEST IME	Chiller data sheet WATER FLOW RATE (m3/h)
OFF	1	19.07.2020 - 26.07.2020	168	214164	16536	98,43	2362,29		2,4	1,2	40
				Water T 10C air T 35C				555			

Test Nr. 2 Chiller electricity consumption with "Smart Cooling" adiabatic chiller booster system											
Status adiabatic system	Nr.	DATE	HOURS USED	DATA SHEET CHILLER ENERGY CONSUMPTION (kW/h) 100% load	CHILLER ENERGY CONSUMPTION (KW) TEST TIME 7 days	CHILLER ENERGY CONSUMPTION (KW/h) AVAREGE 1 hour	CHILLER ENERGY CONSUMPTION (KW h)test time per da1 day	COOLING CAPACITY DATA SHEET (kw/h) 100% cooling load	COP AVARAGE Data sheet 35 C	COP AVARAGE TEST IME	Chiller data sheet WATER FLOW RATE (m3/h)
ON	1	25.08.2020 - 01.09.2020	168	164	5042	27-50	720,28571		2,4		40
				Water T 10C air T 35C				555			



Test Nr.2 – Fluke energy monitoring system shows that when operating for **seven days** with **Smart Cooling™** PRO 10 turned off, the chiller's average electricity consumption was **16536 kw/h.**

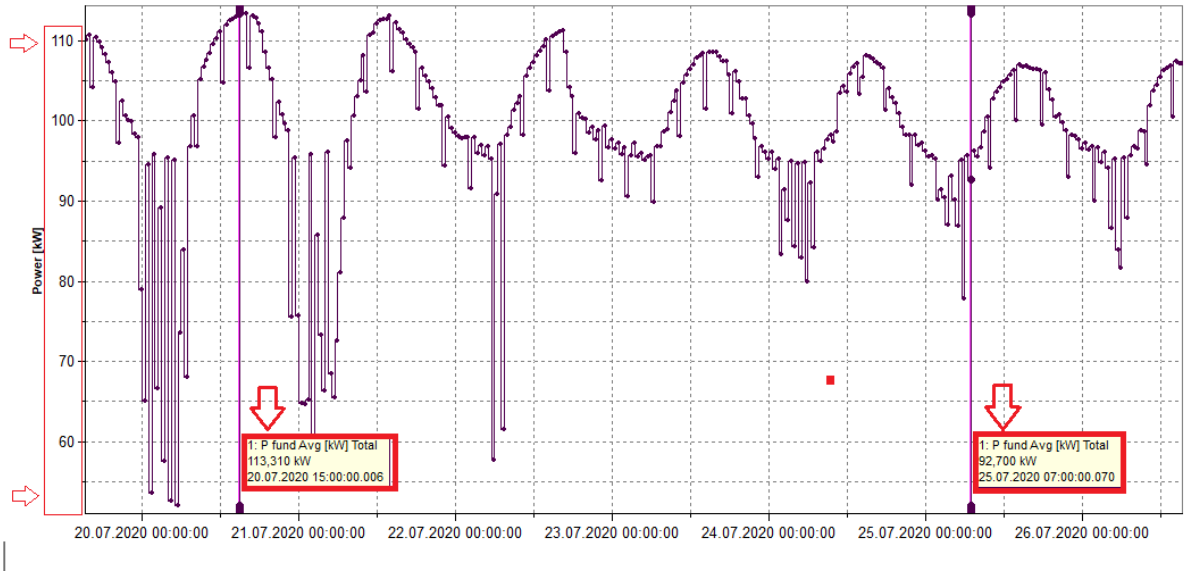
When working for **seven days** with **Smart Cooling™** PRO 10 turned on, electricity consumption was **5042 kw/h.**

Average chiller electricity savings in seven days was 1839.04 SAR (11494 kw/h x 0,16 SAR)

Water consumption in seven days amounted to 20.04 m3 x 6 SAR = 120,12 SAR

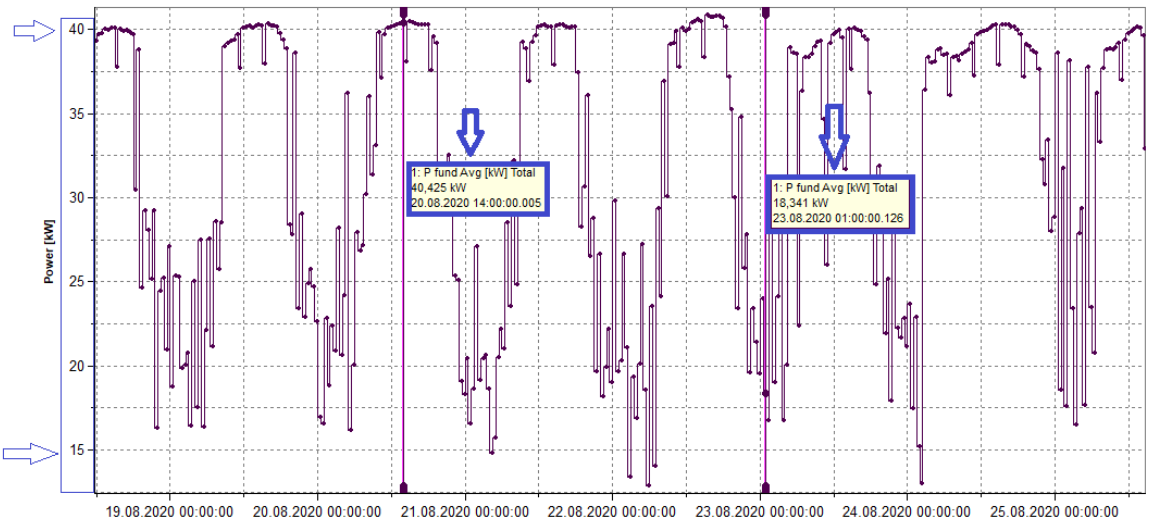
The Fluke energy monitoring system indicated electricity consumption of **92 kw/h – 113 kw/h** with **Smart Cooling™** PRO 10 turned **OFF**.

Fluke energy meter readings



Fluke energy monitoring system Fluke indicated electricity consumption of **18 kw/h – 40 kw/h** with **Smart Cooling™** PRO 10 turned **ON**.

Fluke energy meter readings



Test No.3. (compressor COP test)

Test duration: 2 hours.

To assess the chiller's compressor COP (Coefficient of Performance) a COP test was carried out.

During the COP test were used: an ultrasonic flowmeter, an RIL600W BTU meter and a Fluke energy meter (property of Aramco)

External and return waterflow were measured, as well as water temperature and energy consumption determined in real time against energy consumption.

Compressor COP calculations were conducted on a single compressor, as it was the sole compressor in operation during the conduction of the test. Thus, this Chiller COP test does not indicate all chiller EER (energy efficiency ratio) when operation in changing conditions and under varied compressor loads.

Compressor COP calculations were: 100.18 kw / 42.85 = 2.3.

A comprehensive chiller EER or COP test would show a different picture if the COP test had been conducted for a longer period and under different chiller loads, ranging from 25% to 100%.

It is imperative to note that during the test the building in question did not require enough cooling, therefore a single compressor was operating and chiller load was of only 25%.

BTU meter processor	**BTU meter** clam	**Fluke** Energy meter.
		

Conclusions:

After assessing the energy consumption of a particular chiller for a period of two months, test results of the Zamill ARX 140A chiller with Bitzer piston-type compressors show that, with **Smart Cooling**™ PRO 10 turned off, chiller load is over 45%. When put into operation, **Smart Cooling**™ PRO 10 allows the cooling facilities to save from 25% and up to 69% of chiller energy.

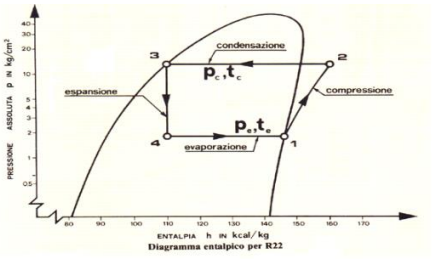
This conclusion can be demonstrated by the following:

The Zamill ARX 140A chiller in question is approximately 20 years old. According to the data performance sheet, we see that at an outside air temperature of 35°C the chiller COP is 2.8. And at a 46°C outside air temperature, the chiller COP is 2.1. It should be considered that this data pertains to a *new* chiller and that the depreciation of piston-type compressors in 10 years is of around 20%. Therefore, the real EER of this Zamill ARX 140A chiller at an outdoor temperature of 46°C is, in fact, likely to be at around 1.5.

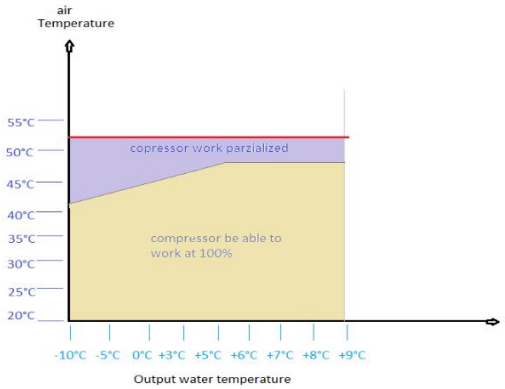
The Zamill ARX 140A chiller with four piston-type compressors operates in an ON-OFF principle. This means that when the cooling load and capacity of a compressor changes, the electricity consumption does not change significantly. The chiller's four compressors all work with a load ranging from 75% to 100%.

After analyzing electricity data, it can be seen that the average electricity consumption of one compressor is of, on average, 50 kWh. In a situation when the chiller load is around 45% and two compressors are running, electricity consumption is of, on average, 100 kWh.

With **Smart Cooling**™ PRO 10 in operation, which dramatically reduces incoming air temperature into the condenser by 15°C and ensures a significantly lower chiller condensing temperature (preventing the chiller from turning on a second compressor) a substantial decrease of 45%-50% in electricity consumption was observed. This enthalpy diagram show the capacity of work the compressor.



cicle and limit of work of semiermetic compressor (piston)



In some instances, such as when three compressors were running (compressors 1 and 2 at full load of 90%-100% and compressor 2 at 10% load) and the chiller load is 60%, switching on **Smart Cooling™** PRO 10 switches off two compressors and works with a single compressor. The resulting reduction in electricity consumption could be observed in the readings by the Fluke energy meter.

Summary

Nr. 1

To summarize the information presented above, it is our conclusion that the electricity consumption of the Zamill ARX140A chiller equipped with the intelligent adiabatic **Smart Cooling™** PRO 10 system consumes, on average and during a 1-day test, approximately **700 kWh**. x 30 days = 21,000 kW/h per month x 8 month = 168,000 kW/h per year.

Nr.2

Without **Smart Cooling™** PRO 10, the average chiller electricity consumption during a 1-day test is of around **2000 kWh**. x 30 days = 60,000 kW/h per month x 8 month = 480,000 kW/h per year.

Nr. 3

Chiller booster water consumption during a 1-day test is of around 2,8 m3 x 30 days = 84 m3 per month x 8 month = 672 m3 per year.

Taking this data set into account, we present the ROI (return on investment) calculation below:

SC statuss		1 day	30 days	8 month
OFF	Consumption avarage kW/h	2000	60000	480000
	Energy price SAR	0,16	0,16	0,16
	Total SAR	**320**	**9600**	**76800**

SC statuss		1 day	30 days	8 month
ON	Consumption avarage kW/h	700	21000	168000
	Energy price SAR	0,16	0,16	0,16
	Total SAR	**112**	**3360**	**26880**

SC statuss	**Savings**	1 day	30 days	8 month
ON	**Electricity saving avarage kW/h**	**1300**	**39000**	**312000**
	Energy price SAR	0,16	0,16	0,16
	Total SAR	**208**	**6240**	**49920**

SC statuss		1 day m3	30 days	7 month
ON	Water consumption m3	2,8	84	672
	Water price per 1 m3 SAR	9	6	6
	Total water coast	**25,2**	**504**	**4032**

SC statuss	**ROI calculation**		30 days SAR	8 month SAR
ON	Total saving SAR		6240	49920
ON	Water consumption SAR		504	4032
ON	Maintenance SAR		450	3600
ON	**Total savings SAR**	(El saving) - (water consumption) - (maintenence)	**5286**	**45888**

Armands Mucenieks

Luca Gallarate

30 September 2020

Annex

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RIF600 | Clamp-on Ultrasonic Meter Calibration Report

Pipe diameter	DN80	Date	15/12/2018
Ambient temperature	29°C		
Standard Device before test	Normal	Model:	RIF600W
Standard Devide After Test	Normal		
Test result	Qualified		
Measured Medium	Water		
Accuracy	1%		
Signal Strength	UP: 90		
	DOWN: 90		
Standard device name	Static volumetric method/standard Meter Method Water Flow/Standard Device		
Standard device accuracy	0,20%		

Test	Standard Meter flow		Temperature	Pressure	Tested Meter Flow		Basic Error		Repeatability	
Point	m3/h		°C	Mpa	m3/h		%		%	
Point 1	101,52	101,47	25,0	0,300	102,27	102,10	0,739		-0,147	
	101,47		25,0	0,300	102,07		0,591			
	101,42		25,0	0,300	101,97		0,542			
Point 2	71,27	71,27	25,0	0,300	71,75	71,75	0,673	0,759	-0,146	0,147
	71,19		25,0	0,300	71,65		0,646			
	71,34		25,0	0,300	71,86		0,729			
Point 3	26,32	26,36	25,0	0,300	26,51	26,55	0,722		-0,132	
	26,36		25,0	0,300	26,56		0,759			
	26,39		25,0	0,300	26,58		0,720			

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
Scale Factor=1

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RIF600 |Test Report misuratore di portata ad ultrasuoni clamp on

Diametro tubazione	DN80		Date	15/12/2018
Temperatura ambiente	29°C			
Dispositivo standard prima del test	Normale		Model:	RIF600W
Dispositivo standard dop il test	Normale			
Risultato del test	Qualified			
Liquido	Acqua			
Accuratezza	1%			
Potenza dei segnali	UP:	90		
	DOWN:	90		
Tipo di dispositivo standard	Metodo volumetrico statico/Misuratore di portata volumetrico			
Accuratezza del dispositivo standa	0,20%			

Test	Misuratore standard		Temperatura	Pressione	Misuratore testato		errore base		Ripetibilità	
Punti	m3/h		°C	Mpa	m3/h		%		%	
Punto 1	101,52	101,47	25,0	0,300	102,27	102,10	0,739	0,759	-0,147	0,147
	101,47		25,0	0,300	102,07		0,591			
	101,42		25,0	0,300	101,97		0,542			
Punto 2	71,27	71,27	25,0	0,300	71,75	71,75	0,673		-0,146	
	71,19		25,0	0,300	71,65		0,646			
	71,34		25,0	0,300	71,86		0,729			
Punto 3	26,32	26,36	25,0	0,300	26,51	26,55	0,722		-0,132	
	26,36		25,0	0,300	26,56		0,759			
	26,39		25,0	0,300	26,58		0,720			

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
Scale Factor=1