ALLWORLD
MACHINERY SUPPLY
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Hybrid Hydraulics Investigation Report

Energy Savings & CO_2 Reduction

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Test Conducted for:

Honeywell

1944 E. Sky Harbor Circle N

Phoenix, AZ 85034

March 20th, 2018

1. Investigation Purpose

Date: March 20th, 2018

Number of units: 1 unit

Info: We have examined total energy savings to show the impact of cost reduction in terms of less power consumption, and reduction of CO_2 by using Daikin *Hybrid Hydraulic Systems*.

2. Condition of Investigation

Place: Honeywell Headquarters, 1944 E. Sky Bridge

Checking points: Check pump models, pressures, flow rates and motor sizes to examine for replacement sizing of Hybrid units.

3. Method of Estimation

Measured actual energy consumption of power unit before and after swap from conventional hydraulic unit to Daikin EHU30 hybrid unit. Sample machine had a KIR 15P-11P-22M-A conventional hydraulic unit before the swap. The new Daikin replacement Hybrid pump is an EHU3007-40-N902 was used to replace the KIR pump. Typically, power savings at the HPU part of the machine is much greater when switching to the Daikin Hybrid Hydraulic systems vs. all conventional power units. Data below is a sample for this machine on energy savings, but can be generalized to most machine tools using hydraulic power units that are conventional.

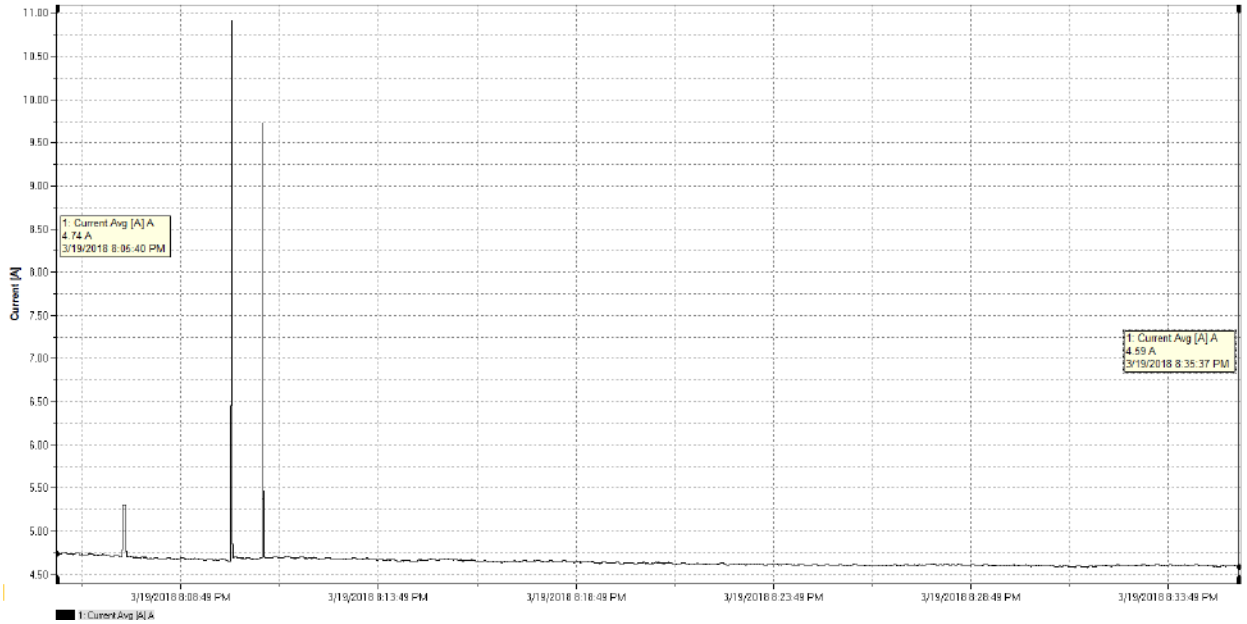
4. How the energy reduction is accomplished

Typical conventional hydraulic power units (HPU's) have a pump that is attached to a motor that sits on or inside a hydraulic reservoir. The motor rotates at 1780 rpm all the time that the unit is powered on. The pump is constantly pumping fluid to maintain pressure at the actuator(s). When there is no demand for fluid (when nothing is moving hydraulically) the fluid is dumped over a relief valve and put back into the tank. Sometimes the fluid is put through a heat exchanger and then to the tank. So anytime that the pump is on, and no actuation of cylinders, chucks, tool changers, etc. is happening, that energy is wasted.

Daikin hybrid hydraulic technology works a bit different than conventional hydraulic power units. First thing to notice is than instead of using a standard ferrite motor, Daikin makes and uses Internal Permanent Magnet (IPM) motors. The magnets inside IPM motors are much stronger than in standard motors and they help produce much higher torque output than standard ferrite motors. They are considered IE3 type motors and are extremely energy efficient. The second thing to notice is the motor rpm's. Using a controller and a pressure transducer, the controller monitors the line output pressure. If the pressure is met, the controller will slow down the motor to about 390 RPM's. When there is a demand (something starts to move) the transducer senses the very small pressure change and sends a signal to the controller to speed up to accomplish the

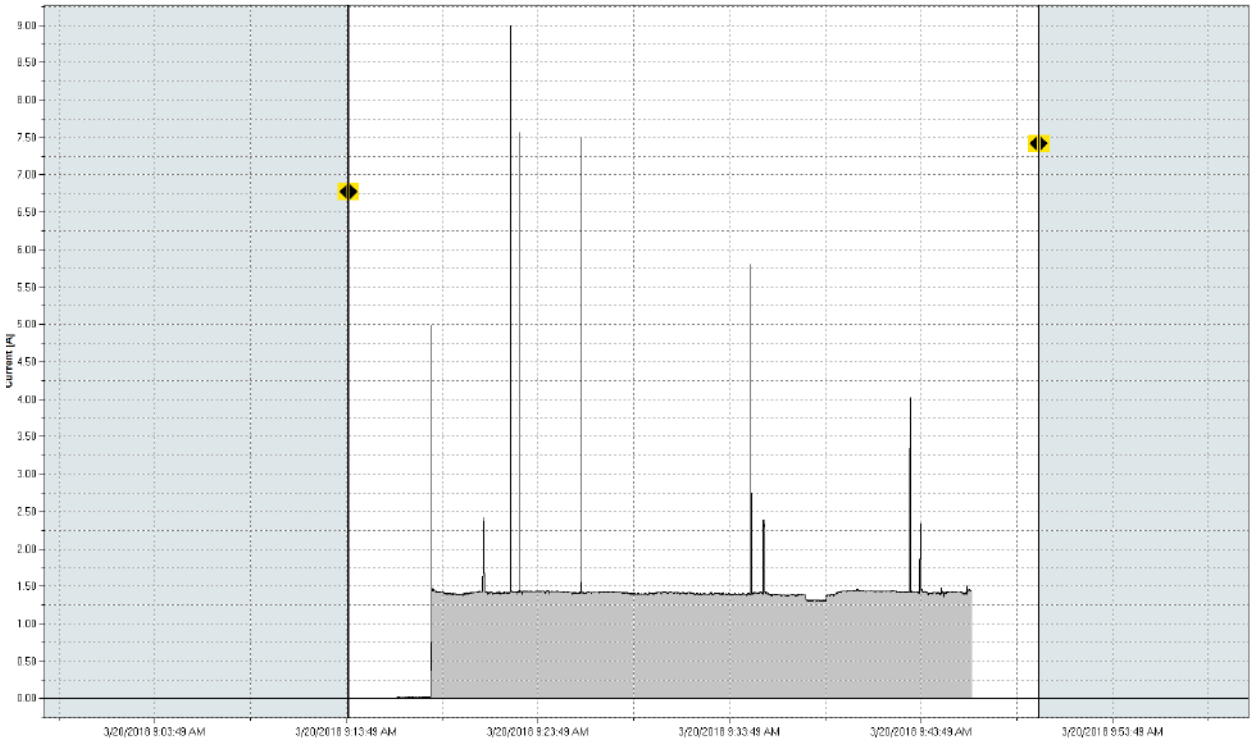
work. The motor can go from 390 RPM to 4000 RPM in about three tenths of a second. Thirdly, while the motor is at idle (390 RPM) it is cycling fluid from the pump, through a heat exchanger and back to tank. Putting 2 liters per minute through the heat exchanger and back to tank helps the unit to operate just above ambient shop air temperature. Oil at these temperatures last longer, won't burn, and slows oil breakdown. In climate-controlled facilities, a lower operating temperature helps reduce work load on heating and cooling the facility.

Diagrams showing power consumption before and after swap over the course of 30 minutes of machine operation.



Power consumption for KIR pump Model # 15P-11T-22M-A

Average amp Draw = 4.59A



Power consumption for Daikin model: EHU3007-40-N902

Average Amp consumption = 1.43A

Calculations

Test was done 19th and 20th of March.

Machine powered on hours: 24h/day x 350 days per year = **8400h**

Rate based on a yearly average of = **$0.11/kWh**

Power rate is based on data provided from Honeywell on average kWh cost.

Average power consumption of conventional hydraulic pump per hour: ***954 watts***

Average power consumption of Daikin Hybrid Hydraulic pump Eco-Rich per hour: ***312 watts***

Power Savings

Average Annual cost of running hydraulic pumps before swap:
(8400 power on hours x 954 watts/hour /1000 kW) x $0.11 kWh = **$881. 50**

Average Annual cost of running Daikin Eco-Rich Hybrid hydraulic pump:
(8400 power on hours x 312 watts/hour / 1000 kW) x $0.11 kWh = **$288.29**

Reduction of CO^2

Reduction of CO^2 is 0.555 kg per kWh.

Old annual power unit power consumption = 8013.6 kWh
New Eco-Rich annual power consumption = 2620.80 kWh
Reduction of kWh: (8013.6 – 2620.80) = 5392 kWh

5392 x 0.555 = 2992.56 kg which is **6598.36 lbs.** of CO^2 annually for just this one machine, and one power unit swap. This is the equivalent of planting 137 trees.

Total Savings

Savings amounts: $881.50 - $288.29 = annual savings of $593.21 for one machine.

This does not include value added of reduction in climate control costs due to lower heat generation, longer lasting oil due to slower thermal breakdown extends life of the oil, and noise reduction (operates under 60 dB, typically operates as loud as a quiet conversation).

Other rebate potentials: Arizona Public Service (APS) offers rebates for an extensive list of prescriptive energy-efficient equipment measures including lighting, HVAC, IT equipment, **motors, variable speed drives**, refrigeration, and building envelope. APS will also pay $0.11/kWh (up to 75% of incremental project cost) for savings from custom projects.