

CASE STUDY ENERGY SAVING IN A GRANULATOR AT CARTON FACTORY

ABSTRACT

This case study explores the installation of the sinusoidal multifunctional motor efficiency controller (SinuMEC) in a granulator at a packaging factory. Benefits include improved motor startup, reduced maintenance costs, reduction of electrical consumption, filtration of harmonics and improvement of power factor.

CLIENT PROFILE

Best Carton Ltd. is Israeli's fastest-growing manufacturer of corrugated containers for agricultural and industrial products. As part of the company's obligation to improve efficiency and protect the environment, waste material is granulated and recycled. The site has a central granulator which operations under a variety of conditions according to the amount of waste materials.



Figure 1: Best Carton Operating Facilities

OVERVIEW

PRODUCT USED

SinuMEC – Sinusoidal Motor Efficiency Controller

CLIENT PROFILE

Manufacturer of Corrugated Containers

APPLICATION

Granulator

BUSINESS NEED

Improving power factor, reducing energy costs, enhancing equipment lifetime and motor startup.

SOLUTION AND BENEFITS

Installation of PowerSines' Sinusoidal Motor Efficiency Controller designed to reduce motor voltage according to motor load, plus improve motor efficiency and lifetime.

BUSINESS REQUIREMENT

Best Carton continuously looks for higher efficiency in all aspects of the entire facility. Due the cost of electricity, Best Carton was looking for electrical energy efficiency solution. Engineering analysis targeted the granulator's motor as the place to start the energy efficiency improvement process.

Granulators must be functional at any load. Since there may be a high load for short times, the granulator's motor power is higher than that required for normal operation. As in many similar locations, the motor runs with a partial load most of the time, a fact that offers significant potential for energy savings.

The central granulator has a 30HP (22kW) motor with direct online (DOL) startup and operates at a less than efficient state due to its variable load.



Figure 2: The Granulator and the SinuMEC

SOLUTION

The factory implemented PowerSines' innovative SinuMEC (Sinusoidal Motor Efficiency Controller) to induce improved motor performance and reliability.

The SinuMEC is built around patented RIGHTVoltage technology which enables control of the voltage supplied to the AC motor. By utilizing proprietary methods for combining three-phase voltage vectors and angles (V V C - Voltage Vector Combination), the SinuMEC controls voltage amplitude while keeping pure sinusoidal waveform, without generating harmonics and EMI/RFI free.

The SinuMEC automatically controls the voltage supplied to the motor, according to its load. In this way, the operation is optimized while keeping the same operating conditions. By reducing the voltage, the SinuMEC dynamically adjusts the full motor power to 100%, 50% or 25% of its original power rating.

RESULTS

The SinuMEC provides 7 benefits to electrical motors:

- Harmonics-free motor startup
- Reduced maintenance and downtime
- Reducing energy consumption
- Reducing conduction losses
- Harmonics filtration
- Power Factor Correction
- Motor protection

Reduced Maintenance and Downtime

In order to reduce the affects of external parameters, such as network voltage level or operating condition, the performance analysis was done over a relatively short period. Maintenance costs and downtime factors could not be analyzed in such a short time, however, figures from similar installations can be used as reference. .

Reducing Energy Consumption

The electrical data was measured using advanced power quality analyzer CA 8334. Figure 3 shows the active (kW) and reactive (kVAr) power with and without the SinuMEC over few minutes of typical operation.

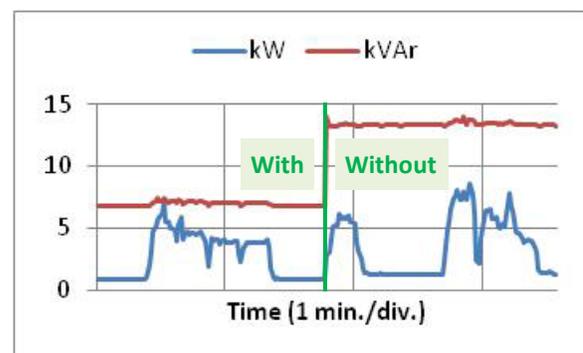


Figure 3: kW and kVAr with and without SinuMEC

Figure 4 and Figure 5 show the active and reactive power during shorter terms, which guarantees an accurate comparison. However, they do not illustrate typical operation - Figure 4 is without load and Figure 5 is while granulating a continuous paper roll which is a relatively low load compared to cartons.

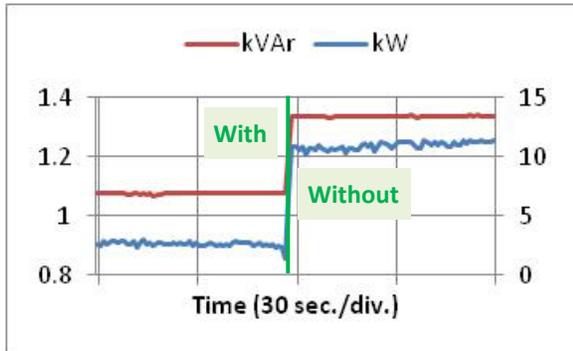


Figure 4: kW and kVAr during no load

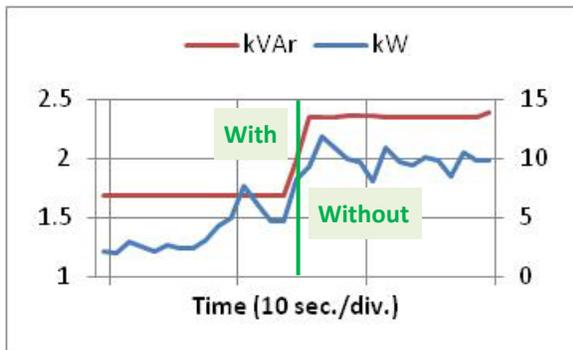


Figure 5: kW and kVAr during small load

Reducing Conduction Losses

Typical conduction losses are 12% of the active consumption and are linear with I^2 . Figure 6 shows the I^2 with and without the SinuMEC during typical operation. The reduction of 70% of conduction losses reduces the electricity bill by approximately another 8%.

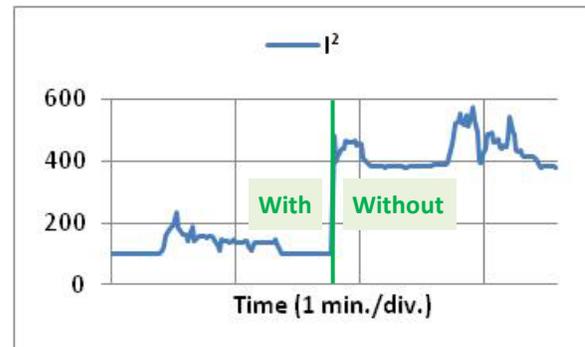


Figure 6: I^2 with and without SinuMEC

Harmonics Filtration

The series reactor inside the SinuMEC reduces the harmonics both at the motor side and the network side. Figure 7 shows the current harmonics with and without the SinuMEC on the network side while Figure 8 shows it on the motor side (the graphs are not at the same time).

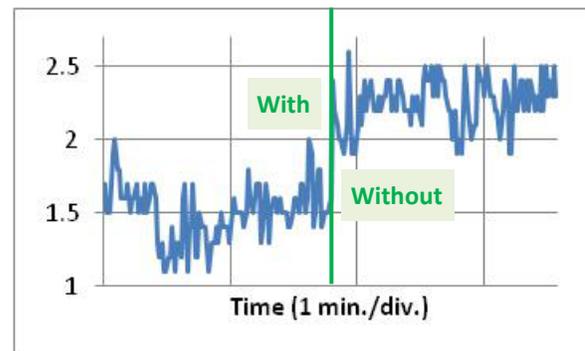


Figure 7: Current Harmonics - Network Side

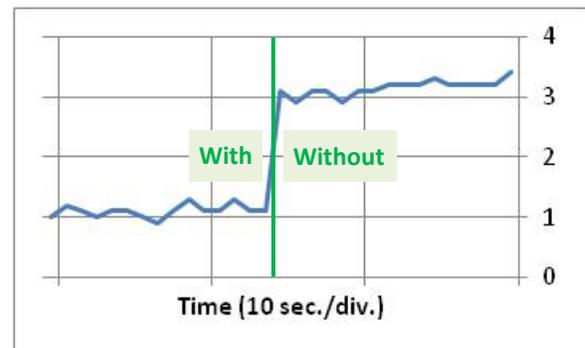


Figure 8: Current Harmonics - Motor Side

Power Factor Correction

The SinuMEC improves the motor's power factor. Since the power factor varies with the load, the easiest comparison is during no load conditions as shown in Figure 9.

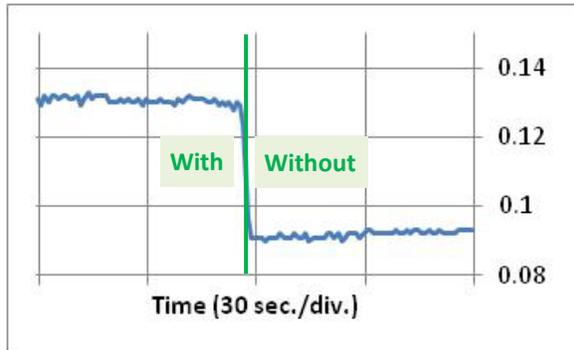


Figure 9: Power Fator with and without SinuMEC

Motor Protection

The SinuMEC includes integral motor protection features, which protects the motor from operating under network failure or internal failure conditions. This feature is operational but was not tested.

ELECTRICAL BENEFITS

The following summarizes the electrical benefits from the operation of the SinuMEC:

- Harmonics-free motor startup
- Reduced maintenance and downtime
- Reducing energy consumption in the motor itself by 15%
- Reducing energy consumption in the conductors by 8%
- Harmonics filtration by 33%
- Power Factor Correction by 50%
- Motor protection



SinuMEC – Sinusoidal Motor Efficiency Controller

FINANCIAL BENEFITS

The financial benefits from installing the SinuMEC are:

- No need to purchase dedicated soft starter due to the integral motor startup.
- Reduced maintenance and downtime at both the motor itself and the granulator belt
- Reducing energy consumption by a total of 23%
- Harmonics filtration reduces the overall facility losses and minimizes the risk of failures and mishaps
- Power factor correction reduces the amount of capacitors required in the central power factor correction system
- Similar to insurance, if no failures occur, the motor protection feature has no financial benefits. On the other hand, if a failure happens, it is of great value.

SUMMARY

The installation of the SinuMEC provides significant benefits, both electrical and financial. It increases the facilities reliability, efficiency and profitability.

Similar benefits were measured in other SinuMEC installations in low or variable load motors, such as conveyors, sifters, compressors, escalators and mixers.