

# Voltage Power Optimisation (VPO)<sup>®</sup>

## CASE STUDY

### Kaysersberg Plastics Gloucester

Installations on 1st April 2006  
and 29th July 2007  
Report 30th April, 2008



*"We are now really starting to see the benefits of our investment, we are receiving savings of approximately 10%... The units will have paid for themselves within two and half years."*

Nick Hitchcroft - Engineering Manager, Kaysersberg Plastics

Kaysersberg Plastics, Gloucester is one of eight European sites for Kaysersberg Plastics, which is a part of D.S. Smith Plastics Ltd, a core division of the D. S. Smith group. The site at Gloucester includes offices as well as the manufacturing plant and has three transformers.

### **powerPerfector unit details**

A 560kVA unit was installed with an 8% optimisation on 1st April 2006 on one transformer, accounting for approximately 40% of the total load for the site. A further two units, 420kVA and a 560kVA with 9% and 8% optimisations respectively were installed on the remaining transformers on 29th July 2007.

Through these installations the following savings were achieved:

- **11% reduction in daily average kWh consumption**
- **£37,000 per year**
- **336,000 kg CO<sub>2</sub> per year**



### **Type of Load**

The electrical load at Kaysersberg Plastics includes lighting circuits for the offices and plant as well as a variety of process machinery for the production of their range of plastic products.

For further information please see full report overleaf.

## FULL REPORT

### Contents

- **Introduction**
- **Overview**
- **The Savings Report**
  - Savings summary
  - Overall savings
  - Conclusions

### Introduction

powerPerfector optimises the voltage and improves the power quality for a whole site more efficiently than any other technology available. Optimising the supply voltage allows equipment to use only the energy it requires to operate efficiently.

For example, providing a motor with its optimum voltage prevents excess heat and vibration, while delivering the required torque and speed. When these effects are aggregated across a whole site, substantial energy savings are delivered. The Maximum Demand of the site is also reduced — typically by as much as 10% — which will help keep the site within its Agreed Service Capacity and may reduce penalty charges.

Installing a powerPerfector improves power quality on a site considerably. The reactance of some electrical equipment is reduced when voltage is optimised, so there is an overall improvement in power factor. Equipment is protected as the powerPerfector eliminates transients up to 25,000V and harmonics are filtered from the mains, while the balancing of phase voltages maximises the efficiency of three-phase equipment. By optimising the power supply at source, the powerPerfector is able to extend the lifetime of all the electrical equipment on a site, substantially reducing maintenance overheads in addition to the energy savings.

## Overview

Following a process of evaluation to confirm the level of optimisation and suitability of the Kaysersberg site for a powerPerfector unit, a 560kVA unit was installed on the 1st April 2006. A further two units, 420kVA and 560kVA were installed on 29th July 2007.

According to Engineering Manager Nick Hitchcroft:

*“The installation was carried out over a weekend, without the two rather obvious green cabinets we wouldn't have known the installation team had been in at all. They were prompt, got on with the work and left the factory cleaner than when they arrived. We had no problems starting up following the installation, but did have a small issue with one of our compressors (the supplier had to change a setting, it's fine now).”*

## THE SAVINGS REPORT

### Savings summary

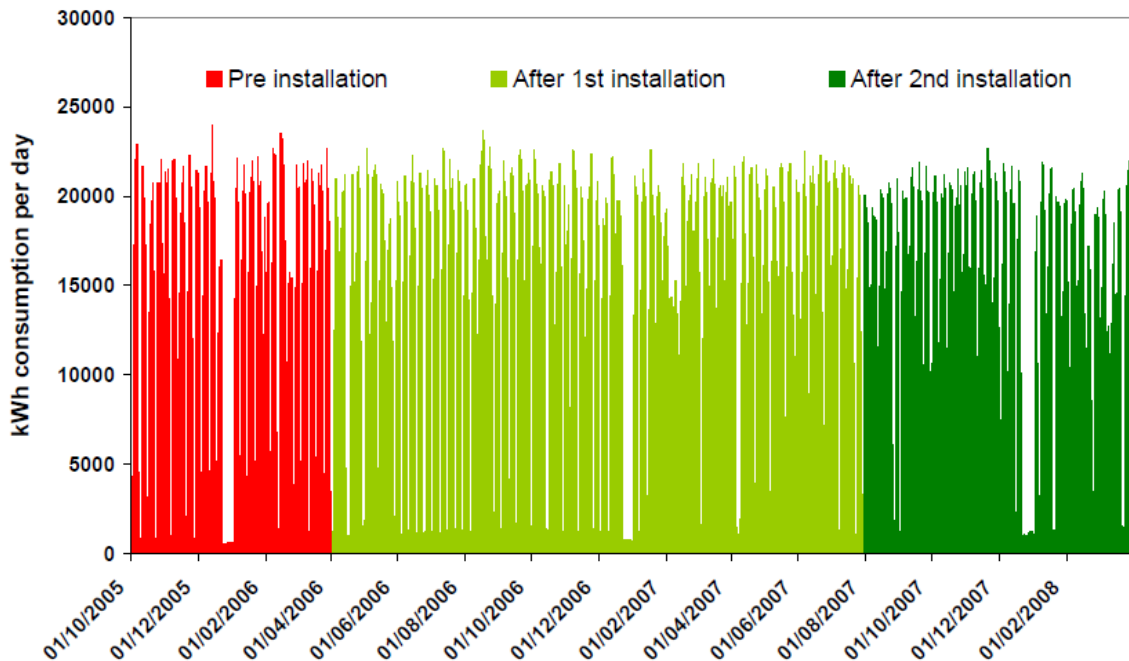
Reduction in daily average kWh consumption	11%
Projected annual kWh saving	625,800 kWh
Projected annual electricity cost saving	£37,000
Projected annual carbon saving	336,000 kg of CO <sub>2</sub>

### Overall savings

powerPerfector has undertaken an analysis of half-hourly consumption data from Kaysersberg Plastics in order to assess the savings resulting from the of the powerPerfector installations.

Our analysis shows that savings of 11% on average weekday consumption have been achieved when comparing the period between 4th January to 31st March 2008 and the same period in 2006. **Figure 1** shows the daily kWh consumption profile from 1st October 2005 - 31st March 2008, encompassing the period before and after the installations.

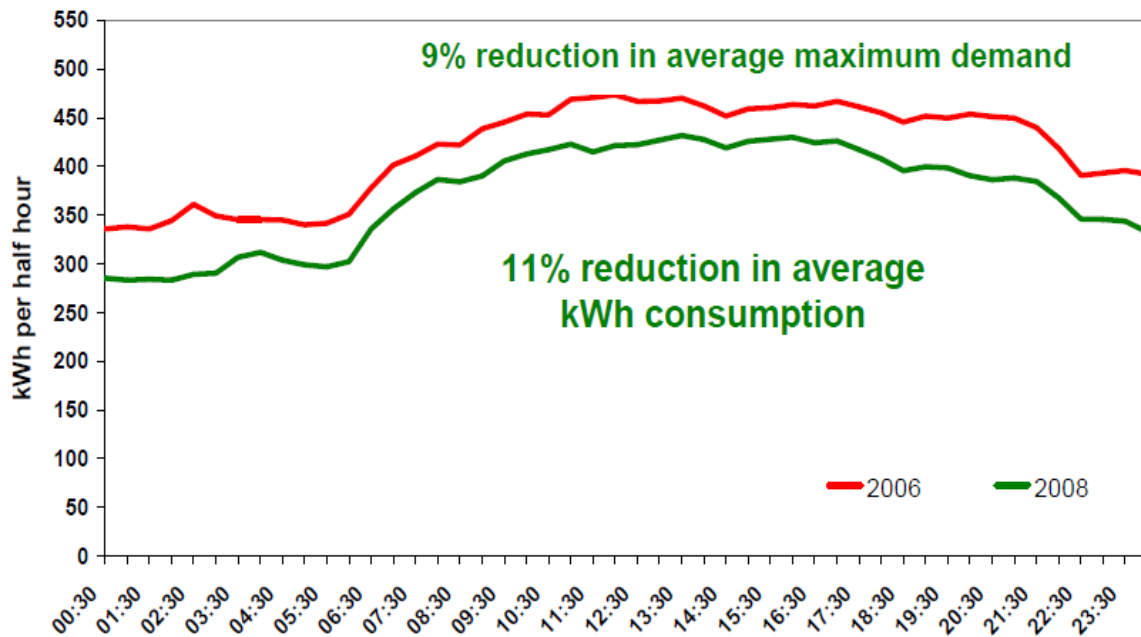
**Kaysersberg Plastics - daily consumption -  
1st October 2005 to 31st March 2008**



**Figure 1**

We have compared the kWh consumption over the course of an average weekday between 4<sup>th</sup> January and 31<sup>st</sup> March 2008 with the same dates for 2006, which is the period before the first installation. On this basis, there is an **11%** reduction in average kWh consumption, combined with a **9%** reduction in average maximum demand. The consumption between 20/02/2006 and 27/02/2006 and between 21/03/2008 and 24/03/2008 was excluded from the analysis because consumption during these time periods was atypically low. The average day consumption for these periods is shown in the chart below, where the consumption for 2006 is shown by the red line and the consumption for 2008 by the green line.

**Kaysersberg Plastics - Average Day -  
04/01/2006 to 31/03/2006  
and 04/01/2008 to 31/03/2008 (weekdays)**



## Conclusion

The powerPerfector is performing as expected. We are delighted to report that there are savings in the region of 11% in the kWh consumption at Kaysersberg Plastics. This equates to an annual saving of 336,000 kg in carbon emissions.

Additionally, the site's equipment is being driven more efficiently by the powerPerfector's higher quality power output, with improved phase balancing, reduced harmonics and optimised voltage.

Equipment lifetimes will be extended as a result, giving further savings going forward that are not included in this analysis. There is no requirement for ongoing maintenance, beyond the standard 5 yearly electrical checks required for all electrical equipment.

## Voltage Power Optimisation Additional Benefits

The ability of VPO<sup>®</sup> technology to reduce energy (kWh) consumption on a site is well documented, but the technology also provides a range of other benefits. These all contribute to creating a more efficient, robust and reliable electrical supply for your site, and provide further financial benefits on top of the reduced energy costs.

### Reduced maintenance burden

- Optimising voltage with powerPerfector brings your supply voltage to the “higher efficiency” operating range of your equipment. Without this, the ‘raw’ supply voltage to your site is likely to be at the top end of the range of voltages your electrical equipment can tolerate. As well as reducing energy consumption, this reduces the **strain** on your equipment, and many of our clients tell us that this increases its lifespan.
- For example, a lightly-loaded **induction motor** operating at an optimum 380V instead of a ‘raw’ 415V experiences less heating and vibration, reducing wear on bearings and prolonging its life.
- The life of **incandescent light bulbs** is almost doubled by optimising their supply voltage.
- Most equipment benefits from the lower ‘**pressure**’ when voltages are optimised. Other examples include Variable Speed Drives – which are particularly sensitive to over-voltage – and the capacitor banks in Power Factor Correction systems.
- When these effects are **aggregated**, the benefit to your site of extended equipment lifetimes and reduced replacement costs will be substantial. The exact saving is difficult for powerPerfector to quantify, but we estimate it to give you a 10%+ reduction of your maintenance and capital replacement costs.

### Improved power factor

- Optimising supply voltages reduces the **reactance** of electrical equipment, as it prevents over-excitation of magnetic components. The effect of this is to reduce the level of wasteful **reactive power** in the electrical system. Reducing reactive power improves **power factor**, and the powerPerfector typically improves power factor by 3-10%.
- The **maximum demand** of a site is expressed in kVA (incorporating both real and reactive power). So reducing reactive power reduces the maximum demand of a site, which will lead to reduced kVA demand charges, Agreed Service Capacity (ASC), and increase spare capacity for further growth. (8% optimisation = 6%-10% reduction in MD normally)

- Power factor **penalty charges** – which are now uncapped in the UK – can be avoided if your power factor is above 0.95. These may appear on your bill as ‘reactive power charge’, ‘kVAr charge’, ‘use of system charge’ or ‘availability charge’. If your power factor is at around 0.9 at the moment, the powerPerfactor could remove your exposure to these charges.
- In general, the strain on your electrical infrastructure is reduced if power factor is good. If your system is carrying a high proportion of reactive power, impedances and voltage-drop will be excessive, and overall **efficiency** will be low. The powerPerfactor improves the electrical efficiency of your site.
- The powerPerfactor yields many of the same benefits as **Power Factor Correction**, but does not use capacitors, which can be prone to failure. Instead, it helps correct the underlying cause of poor power factor, while saving energy.

#### **Lower harmonic distortion**

- The powerPerfactor is able to **filter harmonics** on the mains incomer. Harmonic distortion is on the increase, leading to apparently random failures of electronic equipment.
- As the site is protected from mains-borne harmonics, disruptions to the operation of sensitive **electronic equipment** that could otherwise result from intolerance to harmonic distortion are minimised.
- By preventing harmonics from entering the secondary side of the **HV supply transformer**, the powerPerfactor is able to improve the transformer’s efficiency and increase its effective capacity. Customers whose utility meter is on the HV side of their transformer will see higher savings as a result.
- The threat from damaging **resonance** effects is reduced as harmonic distortion is lower, as is the risk of failure of Power Factor Correction capacitors.
- The **efficiency** of any equipment containing magnetic components is improved – contributing to energy savings – as the heating effect of harmonics is reduced. This in turn extends operating life by postponing the breakdown of insulating materials.

#### **Reduced neutral currents**

- As well as providing general harmonic filtration, the powerPerfactor helps to reduce the level of **triplen harmonics** on a site, by balancing the three phase voltages.

- In addition to the benefits listed above, this leads to reduced **neutral currents** and temperatures – even though the neutral cable does not pass through the powerPerfector – as triplen harmonics accumulate on the neutral. Lower neutral currents are always desirable, and with an increasing proportion of non-linear loads generating more harmonics than ever before, undersized neutrals are a potential risk on many sites.

#### **Improved phase voltage balance**

- The operation of **three-phase equipment** – particularly induction motors – is much more efficient if the phase voltages are closely balanced. For large industrial sites that are heavily dependent upon such loads, balancing phase voltages at an optimum level with powerPerfector can yield energy savings of over 20% in motors.

#### **Protection**

- A powerPerfector makes an electrical supply more robust, and your site better protected. **Transients** – which are very brief surges in voltage from the grid – are eliminated by the powerPerfector, provided they are less than 25,000V.
- This level of protection is able to prevent transients from causing catastrophic damage to equipment, but it also prevents smaller, more common transient events that act to degrade equipment over time. This prolongs the expected life of electronic equipment.

