TCE Transmission LTD

How an Asphalt Production Plant can use Remote Monitoring Technology to Tackle Sustainable Development

Energy Consumption and Cost Savings in conjunction with Carbon Emission Reduction through Remote Monitoring Technology

Tony Condon & Joshua Shaw
24/11/20202

Table of Contents

1.1 Abstract

Remote Monitoring technology is attracting interest in a broad range of industrial engineering disciplines because of its potential to provide an early warning system for problem solving, which could lower cost, improve quality and support multi-discipline analysis for complex projects. This paper reviews the primary components and capabilities of Remote Monitoring technology, calculates and analyses cost savings and in turn details carbon emission reductions within a single asphalt production plant.

1.12 Introduction

Currently, many aggregate engineering industries already have some form of pre-existing monitoring services in place. Condition monitoring is the process of monitoring a parameter of condition in machinery (vibration, temperature etc.), in order to identify a significant change being indicative of a developing fault.. it is a major component of predictive maintenance. The use of condition monitoring allows maintenance to be scheduled, or other actions to be taken to prevent damages and avoid its consequences. Condition monitoring has a unique benefit, in that conditions that would shorten normal lifespan can be addressed before they develop into a major failure. However, this service comes at a high cost in comparison to Remote Monitoring. TCE Monitor bridges the gap between applicational failure/break down and the need for in depth conditioning monitoring services. Remote Monitoring will allow the user to access the performance of specific pieces of plant machinery 24/7, to identify whether the application (eg. Bucket Elevator Drive Motor) is operating as expected. TCE Monitor and corresponding sensors have a substantially lower cost compared to annual conditioning monitoring services. The costing to protect 50% of a large asphalt plant is near to the price of just one high-performance motors (eg. Mixer Drive Motor). In section 1.20, further calculations are detailed to show minimal expected environmental and economic savings and improvement to a single plant.

1.13 Benefits of using Remote Monitoring

Below is a summarised list of benefits and characteristics of Remote Monitoring technology.

- Low-cost installation and monthly data charges
- 24-hour monitoring of automatic lubricators, signalling-systems, bearings, gear boxes and motors
- Receive instant push-notifications to your laptop and phone
- Cellular Technolgy - no loss of data due to power outages or poor Wi-Fi connection
- Oversee and observe systems on a plant location or country-wide basis on a single Portal Dashboard.
- Adjustable time interval reporting
- QR code scanning situated on the monitor, ensures PM completion/ logging.
- Reduced downtime costs – exact knowledge of where and when problems occur
- TCE Monitor can have up to 8 different sensors - maximising problems/error detection
- Rated IP67/68 to withstand monitoring allocated in all environmental conditions

1.14 How It Works

The following is a brief broken down explanation of the basic functioning of the Remote Monitoring system. Figure 1 below is a screenshot demonstration of the digital report for a motor. Where the user can access to check the reports from any application, they have installed remote monitoring technology.

- Powered from a 5-38V input Voltage Sensors are directly connected to the application
- Data is transferred to the monitor, to measure and record the characteristics at set intervals
- Chosen data is recorded into graphical trends. This can display the products performance and produce an accurate product life cycle
- When parameters are set, optimum performance can be used to trigger early warning systems when anomalies in data show, thus indicating action is required.
- Major faults are signalled by a sizeable relative difference in data, this is relayed as a push notification alert
- Data can be accessed on the Dashboard Portal via phone, PC or any device that has an internet connection
- QR codes are located on TCE Monitor's exterior to allow easy checking of specific applications

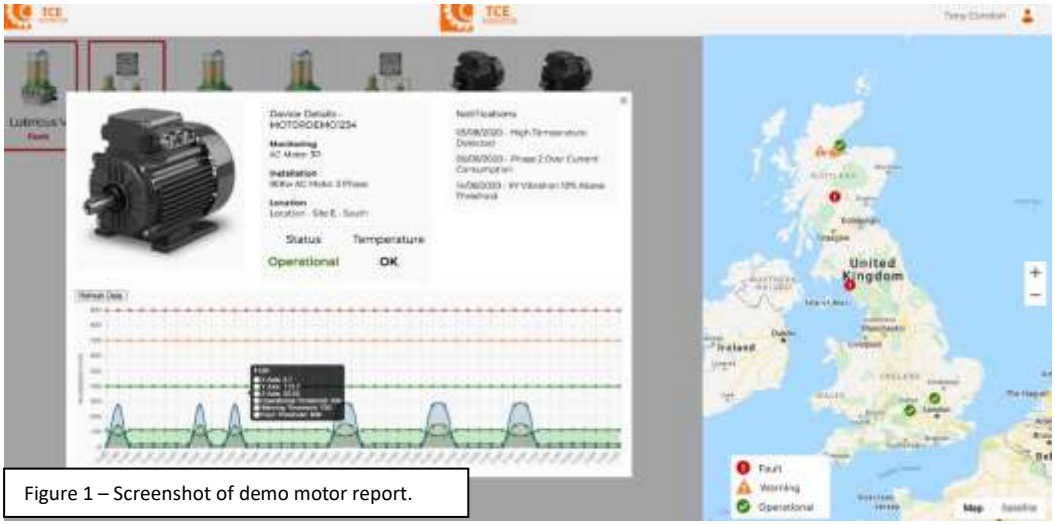

Figure 1 – Screenshot of demo motor report.

1.2 Primary Data used from Tarmac Site Manager resource and percentage energy savings calculated

Primary data is an average number based on previous given data from UK asphalt plant clients. We appreciate that the data used may not be wholly exact to differing capacity at specific sites.

Asphalt produced: 200 Tonnes per hour

Cost of electricity to run 1 site for 1 month: £8000

Site daily operation: 12 hours

1 Tonne of product (Asphalt) is sold at: £65

Calculations in this section have been based on data and calculated estimations from various resources, so values will be recorded as an estimate from true value. Analysis of savings (in red) do not include any other efficiency reductions that may be in place. Total percentage of energy savings with 50% of the plant remote monitored: 10%. For this study we have used the minimal percentage value of efficiency to account for Asphalt Plants of different sizes and variation of machinery.

1.21 Product sustainability in Tonnes (t) - Values derived from known data above

Asphalt produced per month: 48,000 t

Asphalt produced per year: 576,000 t

Monthly product savings: 4,800 t/month

Annual product savings: 57,600 t/year

1.23 Product economical savings – Value of sold asphalt per ton per time-period

Value of sold product per month: 48,000 t x £65 = £3,120,000

Value of sold product per year: 576,000 t x £65 = £37,440,000

Monthly value of added sales due to added production: £312,000

Annual value of added sales due to added production: £3,744,000

1.24 Energy consumption and savings per ton of asphalt produced

Energy needed per monthly production: 1.525 kW x 48000 t = 73,226.54 kWh

Energy needed per annual production: 1.525 kW x 576000 t = 878,718.48 kWh

Monthly energy savings: 7,322.65 kW/h

Annual energy savings: 87,871.85 kW/h

1.25 Price and savings of energy used based on large scale business electricity charges

Price of one kWh is 10.925p for a large-scale business according to (powercopare, 2020). Knowing this we can estimate electricity based on tonnage of product produced and the savings generated.

Price of electricity used in one month's production: 73,226.54 kWh x £0.10925 = £8000

Price of electricity used in one year's production: 878,718.48 kWh x £0.10925 = £95,999.99

Monthly electricity cost savings: £800

Yearly electricity cost savings: £9,599.99

1.26 Carbon emissions per ton of asphalt produced and possible reduction in carbon emissions

Based on figures from (RenSMART, 2020) with carbon rates from a mixed source of electricity with a rate of 1kwh of electricity generating 0.233 kg (0.229 x 10^{-3} t) of Co_2.

Carbon emission per monthly tonnage: 73,226.54 kWh x 0.229 x 10^{-3} t = 16.77 t Co_2

Carbon emission per yearly tonnage: 44,352,000 kWh x 0.229 x 10^{-3} t = 201.23 t Co_2

Reduction in carbon emission per month: 1.68t Co_2

Reduction in annual carbon emissions: 20.12t Co_2

1.27 Summary

This analysis has provided a highlighted appreciation towards the need for installation of remote monitoring technology, in particularly within aggregate production industries. Although the values present (in section 1.20) are not site specific, they provide a 'ballpark' figure of the percentage of cost, energy, carbon footprint savings and reductions. This paper has conveyed an exciting insight into what Remote Monitoring has to offer when only 50% of a site is covered. A long-term project of 100% plant remote monitoring will see these all be arbitrary figures to at least double without including further savings not highlighted in this paper. To summarise, a site that has our monitoring systems in place will be able to produce a greater tonnage of asphalt/product, due to an increase in knowledge of optimisation with product performance. Therefore, the improved running efficiency also translates with an impressive decrease in carbon emissions, due to a reduced electricity expenditure per kilowatt hour required per ton of asphalt produced, maximising final profits from sold product.

Further economical savings can be made, when deducting the expenditure of unnecessary constant need of condition monitoring, as our monitors will provide an exponential alert level to indicate which applications on site need maintenance and the urgency of the problem. To explain this further an amber alert will indicate the need for maintenance engineer inspection or a conditioning monitoring service, therefore a red alert will indicate urgent need of maintenance (of a motor for example). At this stage another saving not published in this paper, would be the product replacement cost when the need for inspection has been ignored/ missed or problems have not been identified at the initial stages of occurrence.

2.0 References

powercopare. (2020). *Business Electricity Rates From 9.81 p/kWh: Price Comparison*. Retrieved from powercompare.co.uk: https://powercompare.co.uk/business-electricity/

RenSMART. (2020). *UK CO2(EQ) EMISSIONS DUE TO ELECTRICITY GENERATION*. Retrieved from www.rensmart.com: https://www.rensmart.com/Calculators/KWH-to-CO2