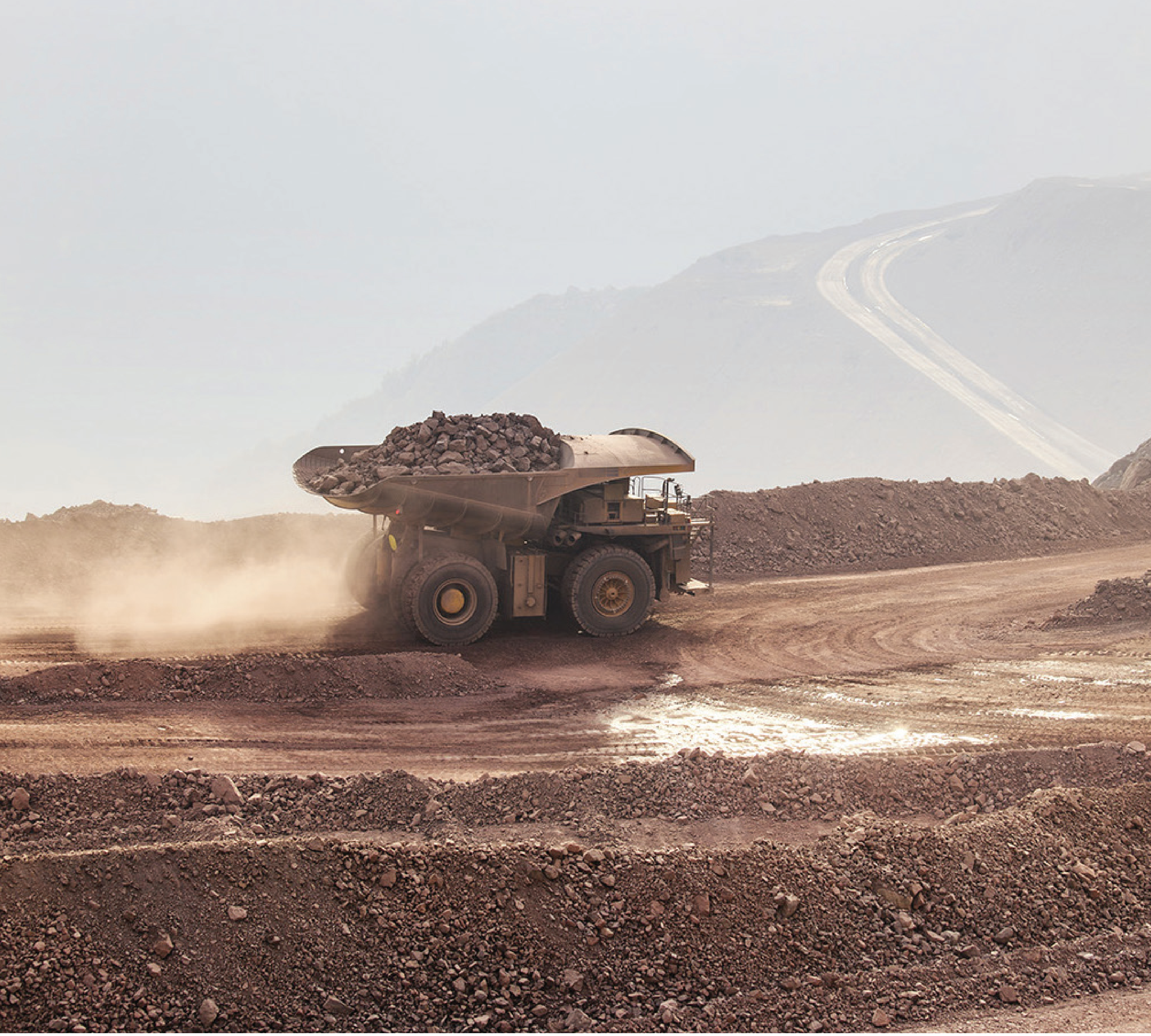


# IoT and condition monitoring: How to achieve cleaner fuel and savings

Combining the Internet of Things (IoT) and Parker's iCount particle detector to predict filter capacity and maximise product life

ENGINEERING YOUR SUCCESS.

# Fuel contamination and how to beat it

Fuel contamination is a problem for many off-road vehicles. Fleets must work reliably

*Gavin Barker*

*Gavin is an applications engineer in Parker's Hydraulic & Industrial Process Filtration Division EMEA. A chartered engineer, he has held technical roles for more than 10 years, with expertise across the power generation, oil and gas and fuel cell markets. Gavin also holds a Master's degree in Electronic Engineering from the University of Southampton.*

**A case for condition monitoring**

With businesses under pressure to minimise downtime and maintain reliable performance, condition monitoring is a major asset in any engineer's toolkit.

Efficient condition monitoring can help save money and lessen maintenance on diesel storage and delivery systems, for minimal installation effort and at low cost.

The Internet of Things has been talked about for many years; but due to the drop in hardware cost and a greater range of affordable cloud solutions, it is now a reality.

**Why diesel needs to be clean**

Diesel used in off-road vehicles needs to be as clean as that used in on-road vehicles. Increasingly complex European emissions standards for engines are leading to higher cleanliness standards. Equally as efficiency trends are prompting injector nozzles to get smaller and smaller, the risk of blockages has risen - potentially increasing maintenance costs.

Running engines on dirty fuel can lead to up to 11% excess fuel burn. Over a whole site, that can lead to significant additional cost. By filtering the fuel and removing free water, the fuel burn of the vehicles can be minimised.

**How fuel gets dirty**

Refinery-supplied fuel must meet locally-specified cleanliness standards, such as EN590 or SANS342 (among others). Contamination is measured in mg/kg, with an upper limit of 24 mg/kg. It is common to meet the mg/kg limit, but not meet the ISO 4406 18/16/13 limit required by OEMs.

Fuel is stored in large bunkers. This type of environment can lead to accumlations of numerous contaminants, including:

- **Condensation**
- **Rust**
- **Pipework debris**
- **Dust.**

Contamination can also occur where fuel bowsers are used to deliver fuel to static machinery.

**Free and dissolved water**

Fuel can contain both free water existing as water droplets alongside the fuel, or dissolved water within the fuel. Free water enters the system through storage tanks and should be removed from the fuel with water separators; however time needs allocating to allow the water to settle in the storage tank.

Free water typically leads to injector wear, power loss and corrosion within the fuel system. Dissolved water can also cause power losses within the engine; but it's less of an issue unless the fuel temperature changes - for example, in forwarding tanks or left in the vehicle fuel tank overnight. In such cases, the water can condense out and become free water.

Water in storage tanks can attract micro-bacterial growth if it is not regularly drained - leading to clogged filters.

Refinery-supplied fuel must meet locally-specified cleanliness standards, such as EN590

# Particle detectors for cleaner fuels

## The benefits of monitoring fuel delivery with a particle detector, such as Parker's iCount series

By using a particle detector that can determine fuel cleanliness and report using ISO 4406 codes, the system can be checked at strategic points to ensure the fuel is adequate for use.

With the Parker iCount Particle Detector (IPD), the ISO code is displayed on the unit - so it can be easily checked.

**Adding a particle detector to a system**

Adding an IPD to a system is relatively simple. A controlled flow of 60ml/min is required to pass through the sensor, with at least a 2 bar pressure drop.

By monitoring the fuel delivery, it can be checked against the supplier's specifications; any discrepancies can be noted and discussed with the supplier. If the fuel does not meet the stated specification when it is delivered, then the filter system will have to work harder to meet the required cleanliness standards - leading to more filter changeouts and more cost to the operator.

By measuring downstream of filtration skids, it is possible to check the effectiveness of the filters and ensure that the system is operating as intended. Using the relay within the IPD, forwarding pumps can be stopped if the fuel goes outside of specification; alternatively this could be used to toggle a changeover valve on duplex filter systems.

Changing filters when they need to be changed (rather than on a time- or volume-based schedule) both maximises filter life and ensures that the filtered fuel is always to specification. As the fuel entering the system can have a range of contamination levels, no two time-based or volume-based filter changeouts will have used the same capacity of the filter.

Ensuring that filters are changed when they should be (or changed at all) leads to the correct fuel entering the vehicles. Clean fuel leads to lower maintenance costs and reduced fuel burn.

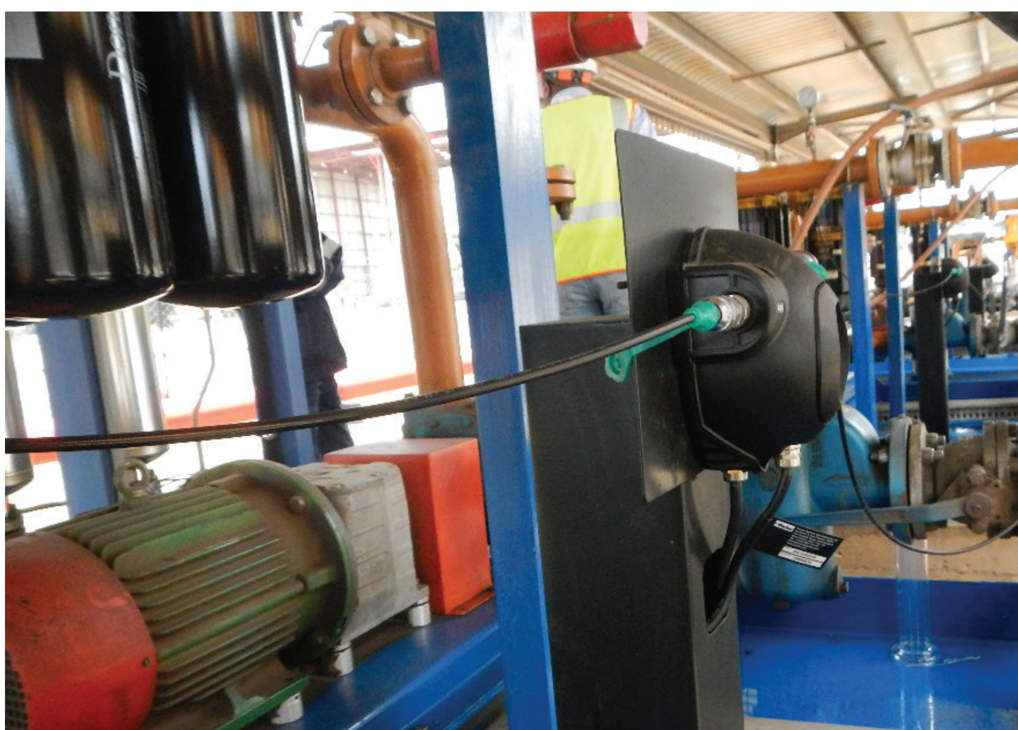
**Manufacturer specifications**

Manufacturers will specify the cleanliness requirements (for example, ISO 18/16/13) at the machine fuel tank. On-board filtering then improves this further: some manufacturers require 12/9/3 at the fuel injectors on common rail diesel engines.

Fitting an IPD to the vehicle itself can be used to monitor the on-board filtration system. As the IPD is rated to 420 bar, it can also be used on the hydraulic system where contamination can lead to pump wear and issues with delicate hydraulic equipment. When used in a hydraulic system, combining the IPD with the System 20 sampling points, an IPD can be added to a system quickly and easily. A cleanliness level of 19/17/14 is commonly required for the hydraulic system.

By connecting the IPD to the cloud using Internet of Things (IoT) connectivity, it is possible to take monitoring one step further, using the data captured and algorithms to predict when filters will reach their capacity.

iCount particle detector (IPD) installed on a fuel forwarding skid



# Case study: A mine in Zambia

By predicting cleanliness and reducing fuel burn, a copper mine is saving more than $5 million each year.

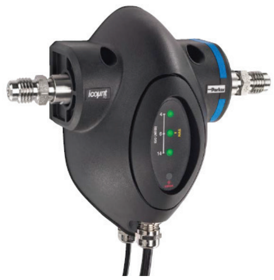
A Parker solution partner customer, Fuel Decon, has combined an iCount particle detector with its own IoT solution at a mine in Zambia, Africa.

By using IoT, the detector display does not need to be read locally; data feeds from the IPD to the cloud 24 hours a day, seven days a week. Analytics from the feed are used to recommend when the customer should change the filters on their fuel forwarding skids.

The mine consumes approximately eight million litres of diesel each month to run the static and mobile equipment. Adding the Fuel Decon system and changing from a cleanliness level of 21/19/13 to 16/14/11 has achieved the results in the table overleaf.

By reducing fuel burn due to clean fuel, the mine **saves more than $5 million annually** in fuel burn alone, plus **an extra $200,000 in reduced maintenance costs**. Although filters must be changed more frequently to meet cleanliness targets, their lifetime is maximised.

The savings achieved far outweigh the extra $94,000 annual cost of filtration and the cost of Fuel Decon's analytics. This approach also ensures that production operates at maximum performance. Fuel Decon has since extended its service to include fuel offload, post bulk filtration and mobile bowsers. By tracing the fuel through the entire mine, any contamination can be detected and removed before it reaches the fuel injectors.



Parker's iCount particle detector

By tracing the fuel through the entire mine, any contamination can be removed before it reaches the fuel injectors

> *"With the IoT, things can get complex if you have to work with agents, sensor suppliers, IOT connectivity suppliers, Cloud server suppliers and so on. Our end-to-end services, used with Parker's iCount particle detector, streamlined the process - achieving great results for the customer."*
>
> **— Chris Chow, Fuel Decon**

# Cost-benefit analysis

Annual advantages to fleet owner following introduction of new solution

| | Before | After | Saving | Improvement |
|---|---|---|---|---|
| ISO code | 21/19/13 | 16/14/11 | | |
| Diesel consumed/month (million litres) | 8 | 8 | | |
| Filtration change out above plan | 190% | 5% | $115,000 | -185% |
| Unplanned injectors replaced/month | 8 | 0 | $27,264 | -100% |
| Unplanned fuel pumps replaced/month | 2 | 0 | $66,934 | -100% |
| Average fuel burn litre/hour reduction | | | $5,025,210 | -10.9% |
| Fleet mechanical availability increase | | | | 14.8% |
| Bank cubic metre increase | | | | 33.0% |
| **Total** | | | **$5,234,408** | |

# Filtration is not the enemy

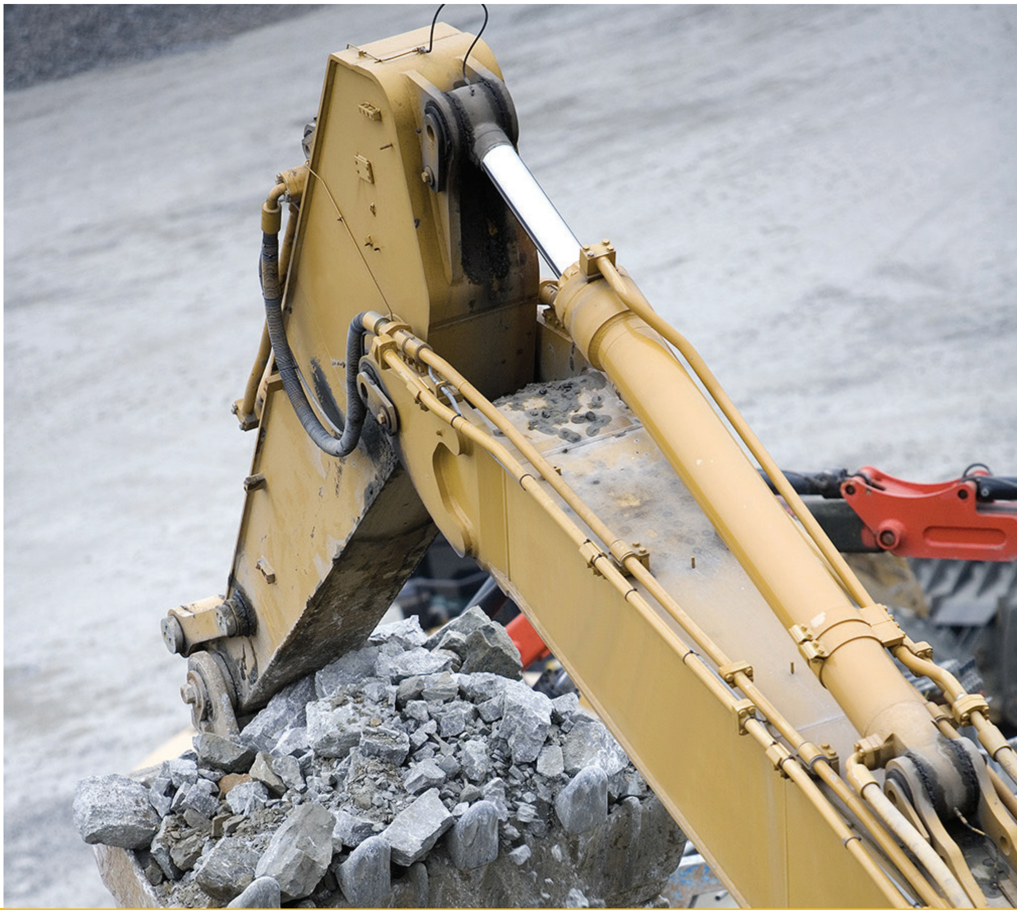
The savings of correct filtration far outweigh the cost of filters

Fuel consumption is a major operating cost for many businesses and the desire to minimise this is self-evident. Often it is tempting to push filter change-out and maintenance intervals further apart to reduce expenditure on filtration, however this has the effect of increasing cost, not decreasing it.

Ensuring that filters are operating correctly allows throughput to be maximised and production maintained, whether for fuel dispensing as explained here or within other industrial processes.

Savings also come from reduced downtime due to unplanned maintenance, where the cost of deferred production can be significant.

In the example above, the payback was only two weeks.



# Condition monitoring & IoT takeaways

## Three key reasons to get started with operational monitoring

Adding a Parker iCount particle detector is simple and straightforward. Installation costs are low and when combined with IoT functionality, the return on investment is typically days or weeks.

By ensuring that filters are changed when they need to be, clean fuel is delivered to engines. This helps to minimise fuel burn and reduce maintenance caused by contaminants in the fuel system.

By combining fuel cleanliness knowledge with the cloud computing capabilities of IoT, it is possible to generate an intelligent system. This approach generates three major benefits:

**1. Visibility of results**

Using a combined particle detector and IoT solution permits the results to be seen almost immediately.

**2. Financial/cost efficiency**

Filtration has often been seen as a cost or an overhead, but it's really a way to ensure that equipment operates at its maximum performance.

By changing filters when needed, filter lifetime and equipment performance is maximised while cost is minimised.

**3. Easy remote monitoring**

The cloud connectivity offered by IoT means that the data can be seen anywhere - which means it's ideal for remote sites or unstaffed locations.

If you need to monitor multiple sites, the data for all of them can be shown in one place.

# Particle detectors: not just for fuel

As well as providing a highly efficient way to tackle fuel contamination, particle detectors can help to transform performance in a range of other applications:

**Hydraulics**
The most damaging contaminants in hydraulic systems are normally between 6 and 14 microns and therefore cannot be seen by the naked eye.

**Lubricating oils**
Using a particle detector can give early warning of wear particles within the oil, allowing for proactive responses to in-service issues.



Print Reorder Number CK52102 December 2020

Parker Hannifin Corporation
**Hydraulic & Industrial Process Filtration Division EMEA**
3-6 Thorgate Road,
Littlehampton, BN17 7LU, UK

www.parker.com