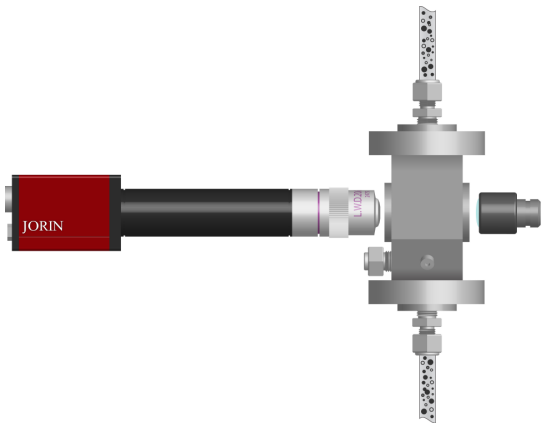
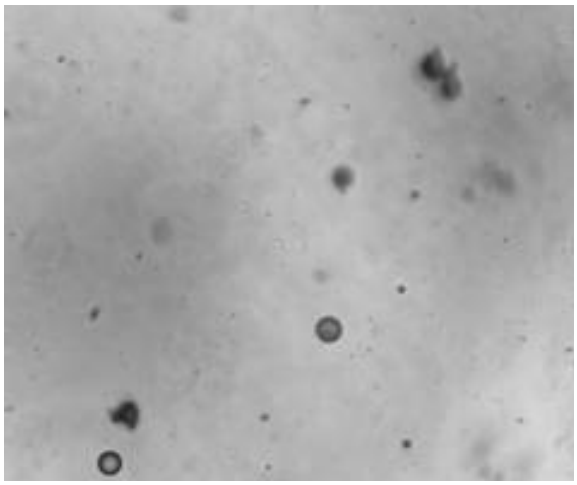
InVA – The Industrial Visual Analyser
Surface Run-off Water Application Sheet

The **InVA**, **I**ndustrial **V**isual **A**nalyser, is an on-line instrument that can be used for the monitoring of particle, droplet sizes and concentrations. The InVA can operate continuously on-line at high pressure and elevated temperatures. The materials that the InVA is constructed from, 316 Stainless Steel and industrial sapphire, ensure that continuous and reliable operation is maintained in a wide variety of inhospitable environments. The InVA can analyse any optically transparent fluid and is predominantly used for produced water and sea water applications in the oil and gas industry.

The ViPA uses a video microscope in a rugged assembly consisting of a video camera and lens and a light source to examine the contents of a liquid, contained in the measuring head. Sample fluid flows through the ViPA's cell module, which has a pair of transparent windows, and the camera looks through the water at the light source. This provides the video microscope with a backlit view of the objects in the water flow, whether these are solid particles, liquid droplets or gas bubbles.





The ViPA operates by freezing a single frame of the video image and analysing the objects present. A database of information is built by rapidly acquiring and analysing sequences of these frozen images. Using image analysis techniques to differentiate between particles, droplets and gas bubbles the ViPA monitors, and records data on, up to seventeen parameters about each particle and droplet continuously in real time which include **size (microns) and concentration (ppm).**

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In many situations where surface run-off waters have to be treated to remove contamination prior to discharge to the environment, on-line monitoring has been problematic.

In refineries, chemical processing plants and many surface run off water situations the sources of contamination can vary dependent on the process plant being operated, the raw material being used or refined etc. and the environmental conditions These variations can occur quickly causing significant differences in the types of contamination present and the concentration of these contaminants.

This can result in the drift in the accuracy of measuring techniques that are reliant on calibration against a specific material type or are unable to differentiate between different types of contaminant.

In these situations it is helpful to have a monitoring technology which uses a measuring technique independent of the contaminants being measured.

The Jorin InVA system provides online monitoring continuously, using image analysis techniques that are entirely independent of the contamination being measured.

Using image analysis it is possible to look at many different physical properties of each particle, including the shape, centres of gravity, fractal dimensions, etc. If a type of particle within the process stream can be characterised by a parameter, or any combination of parameters that the InVA measures, then these particles can be categorised as a sub-population and measured discretely.

Hydrocarbon droplets in water can be characterised most simply by their shape. Liquid in liquid emulsions are almost perfectly spherical. The InVA can determine if any given particle is spherical enough to be a hydrocarbon droplet and then add this information to the appropriate database. Solids are normally irregular but even different types of solid material can frequently be identified, for example, sand is rough in shape and translucent, rust is rough in shape and more opaque and biogrowth is smoother in shape and translucent. The InVA coupled with Jorin's extensive field experience is able to differentiate between these very different types of material that need completely different solutions, screens, corrosion inhibitor and biocide.

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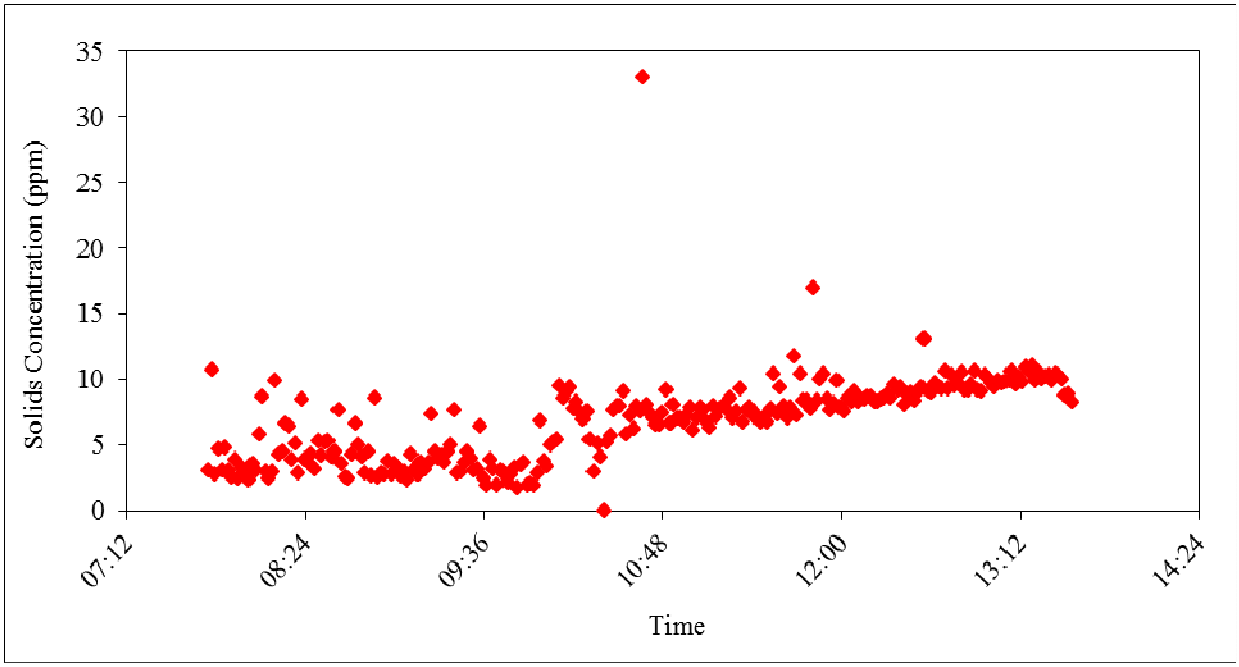
Properties such as size distribution and relative concentrations of populations including hydrocarbon and solids can be monitored and information that is relevant to environmental discharges, separation process and solids loadings on rotating machinery can be reported.
However useful this information is, it only relates to what has already happened. The InVA, operating in continuous mode, takes data from each sampling period and adds it to a trend database. The trend database is then used to predict what is likely to happen in the process in the near future.

For example, the InVA could be set up to monitor the concentration of particles in discharge water. The alarm functions could be set to give advanced warning that the concentrations are tending towards the discharge limit. Pre-emptive action can then be taken to improve the water quality as necessary.



Data showing a solids discharge that while within the limit is trending towards non-compliance.

Of course is some cases changes happen over very short time periods and it is only possible to react as an event occurs but even in this case the InVA can provide early warning. In the following graph a sudden event resulted in a significant increase in solids being discharged and would result in a non-compliance but InVA can alarm on a rate of change allowing an operator to choose to continue discharging, if this was a planned event, or perhaps to divert the water to a treatment process or storage vessel o avoid the non-compliance.

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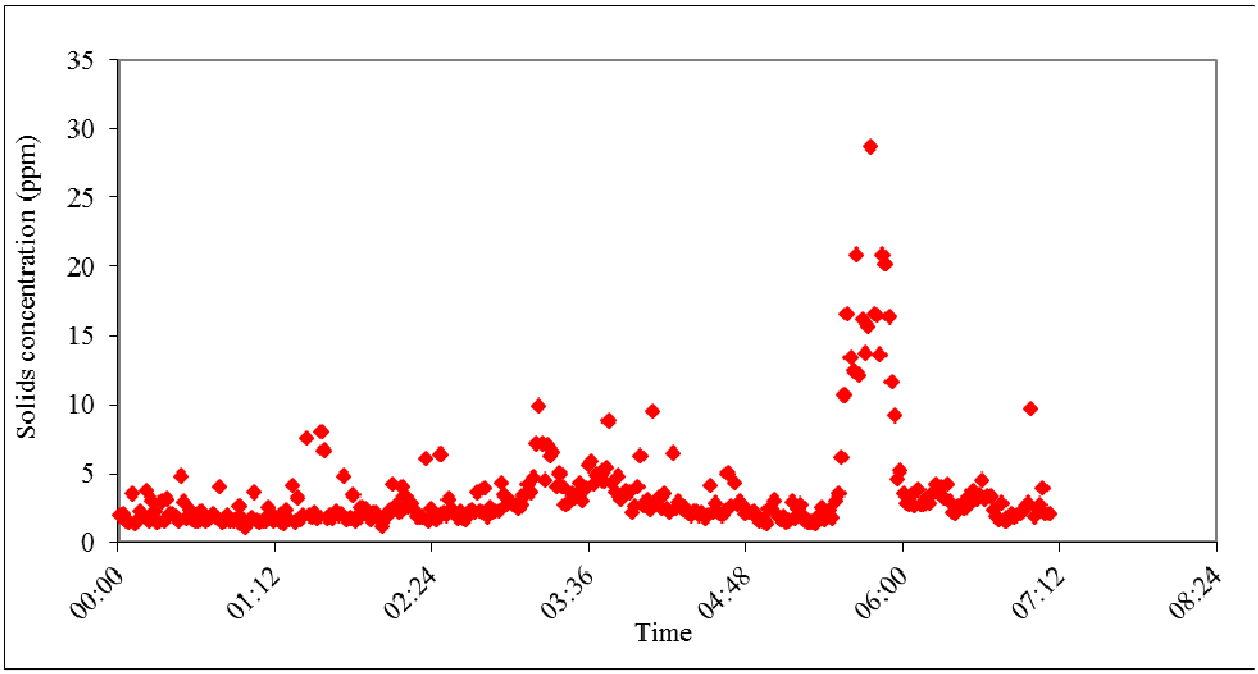

Data showing a solids discharge with a sudden transition through non-compliance

Of course, a monitoring technology has to provide data that is useful in relationship to the process being monitored but this data also has to be meaningful in the context of absolute reference points.

The graphs below show the correlation data sets for InVA compared with a Laboratory IR method and a total suspended solid measurement using 0.45 micron Millipores filter papers; the analyser was installed to a discharge point within a refinery to monitor discharge of hydrocarbon and solid particles to the environment – within a sensitive estuary location.

In both cases good correlations were achieved against the locally recognised laboratory method and the operator was granted a dispensation to use the online data for compliance monitoring, reducing the number of manual samples required from 2 per day to 1 per week.

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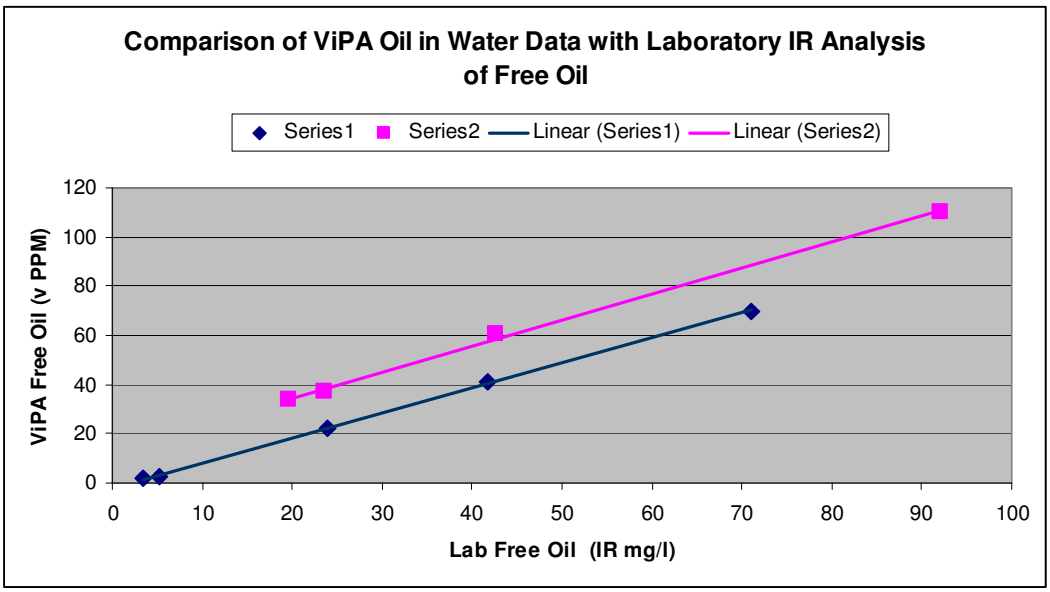
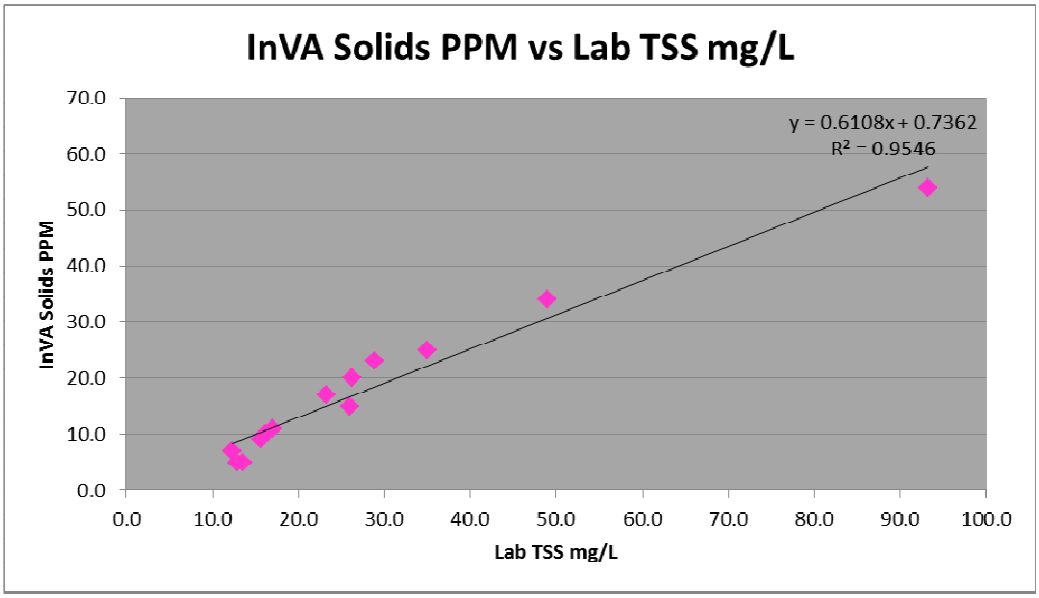
Here the correlations have been drawn to show the InVA data output of free oil in a volumetric concentration reading and the laboratory free oil only in mass per volume concentration. It can be seen that for both cases the correlations are almost identical to those that included the dissolved oil

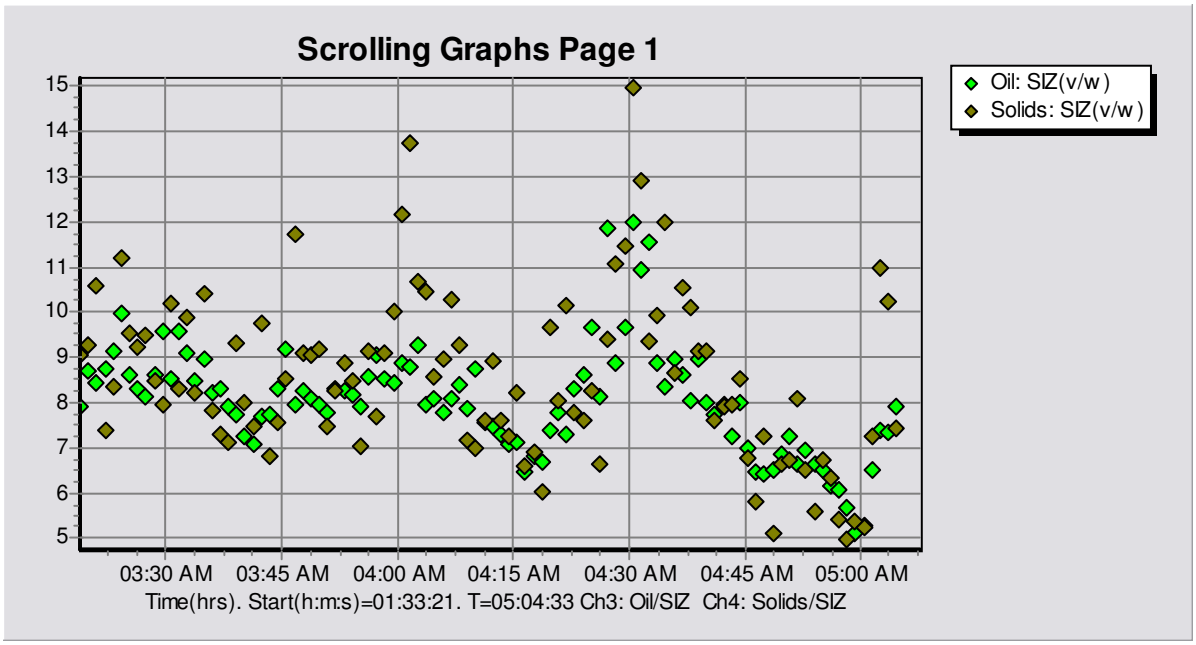




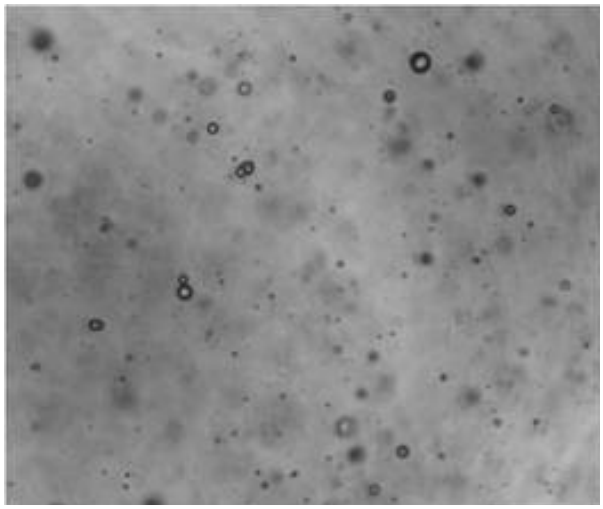
Here correlations are made between the InVA data output of solids particles reported in parts per million compared with a standard Total Suspended Solids method reported in mg/l. It can be

seen that the values are significantly different as InVA reports volume of solids and the lab method reports mass but the correlation is strong

InVA reports more than just concentration data, it also provides full size data which can be critical diagnostic information for solving processing problems and critical separation data and in the graph below the scrolling size data for an oily water separation process for both the oil droplets and solid particles are shown.



The final and most human of the data sets that InVA provides is the constant live video feed from the analyser microscope – the ultimate diagnostic tool for expert and novice alike – **you can see what is in the process line!**



You can see the droplets, the solids, how big they are and how many there are – if there are more or fewer now than there were and exactly how clean your process or discharge is.

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