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Particle Counting and PQ index

Question:

Because of the problems and shortcomings of using a Laser Particle Counter to determine the ISO code of our lubricants, the laboratory we use has purchased an instrument called a "Particle Quantifier" (PQ index).

Is this a better instrument than a Laser Particle Counter?

Answer:

Firstly, it is the condition of your lubricant that is the problem, not the particle-counting instrument. Laser Particle Counters do an excellent job for that which they are designed – to determine the ISO code of relatively CLEAN and HOMOGENOUS lubricants.

Having processed samples of your oil and analysed the ISO code using an optical microscope (in accordance with ISO 4407), they are far too dirty to be analysed by an automatic laser counter. The samples exhibit so much particulate and contamination it is doubtful the lubricant could be recovered by filtration. The quality of the samples suggests it will be far more economical to discard the oil and replace it with new.

The term used for this complimentary instrument being purchased by your laboratory is somewhat misleading.

The term "Particle Quantity" conjures up images of an instrument that quantifies the number of particles present. Nothing could be further from the truth.

In very simple terms the instrument works on the basis of passing the oil sample through a magnetic field, and the amount of distortion of the field recorded.

There is no standard unit of measure to report the result, rather an "index" is provided. The index will vary from brand of instrument and from laboratory to laboratory.

Since the basis of the instrument revolves around magnetic fields then it obviously is concerned with the detection of ferrous (magnetic) material only. It is the mass of ferrous material present that the instrument detects rather than the numerical quantity of ferrous particles present.

PQ indexes are useful for SCREENING purposes for large amounts of ferrous material only. It is normally the first test a laboratory carries out. A high PQ index will trigger more in-depth analysis.

They provide a comparative index only and not a definitive measure of what is occurring in the machine.

Any attempt to establish a condition-based trend using the PQ index should be done so with great caution. Whilst some instruments use a defined measure of the oil sample, others pass the sample bottle, as received from the customer and regardless of the volume it contains, through the instrument and then provide an index.

Obviously, a larger sample volume will contain a larger mass of ferrous material than a bottle with a lesser volume, and a different result will be recorded. It is also known that a sample bottle well mixed provides a different result to that of a bottle where the material is allowed to settle on the bottom.

We conducted some research where a set of samples with a range of known Fe (iron) levels were sent to a number of oil analysis laboratories. (certified Fe powder measured gravimetrically into appropriate ppm values of the samples)

No correlation between the actual level of Fe (iron) and PQ index was apparent. Increasing the Fe (iron) level of the sample did not result in a corresponding (or even anything resembling) a proportional increase or decrease in the PQ index number. (In doubling the ppm level of Fe, one would expect a doubling or some proportional change in the PQ index. This did not occur)

These same samples were also analysed using a modified technique developed from the ASTM standard acid dissolution method. These results provided a closer relationship with the known Fe ppm values of the samples.

The conclusions from these findings suggest the PQ instrument is useful for screening purposes only and extreme care should be exercised if attempting to read anything more into the result it provides.

The PQ index is most commonly used to compliment ICP in an attempt to account for the ferrous particles larger than 3 to 8 micron (depending on which ICP unit being used) that are outside the detection limit of the IPC instrument.

It is an after the event analysis…….that is, large magnetic particles are already being generated, and the wear level is not being controlled. It is a reactive screening technique warning further analysis is required.

If your system is not operating within the recommended ISO cleanliness level then you will no doubt have a PQ index to monitor.

If you have a catastrophic failure occurring, it will highlight the increased amount of magnetic material present…….but if you were proactive and were monitoring your ISO code you would have identified that an issue existed much earlier.

Generally, where equipment is operating within its recommended ISO code no PQ index is apparent.

In summary, the PQ index is a good screening tool to quickly establish if a catastrophic failure has occurred or a condition outside the parameters ICP analysis can detect is occurring.

It can be a useful technique depending on where you sit on the ladder of maintenance maturity, or what strategy is applicable to a particular compartment. (eg; run to failure, reactive, predictive, proactive etc)

It is an after the event analysis tool, and where your are applying a proactive strategy to a compartment it **does not** replace the function of an automatic particle counting instrument.