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# Think Differently: Prevent Failures and Extend Spiral Freezer Gearbox Life

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**Spiral Freezers are critical machines in the Food and Beverage Industry where the freezing of products is a requirement**



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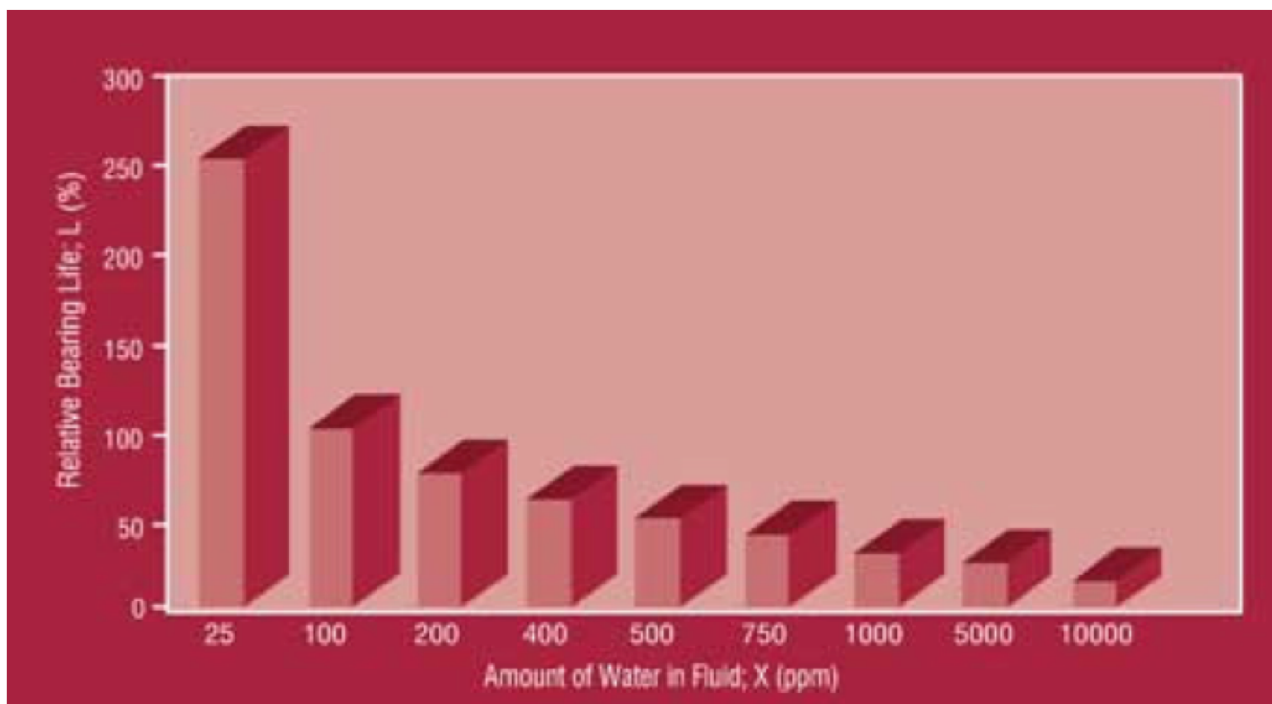
## Introduction

Spiral Freezers are widely used in the food and beverage industry to freeze products. The Spiral Freezer is a Spiral conveyor driven by a centrally mounted motor and gearbox. Failure of the drive gearbox is a major headache due its placement (underneath the Spiral) as well as high replacement cost. The financial impact is not only restricted to physical replacement or repair costs but also loss of product (on the conveyor at time of failure) and sales due to loss of production.



**Figure 1: Damaged Planetary gearbox due to moisture in the gearbox**

The major cause of failure is water formation or condensation inside the gearbox due to the low ambient temperature. This moisture ends up in the lubrication oil. Moisture in oil is very destructive and has a major impact on bearing and gear life. It also causes corrosion as can be seen in the above picture. The graph on the next page was generated by Noria Corporation and it indicates the effect of moisture in lubrication oil on bearing life. As can be seen the shortening of bearing life is exponential with every 1 ppm increase in moisture content.



**Figure 2: Effect of Moisture in Lubrication Oil (Noria Corporation)**

In order to protect the gearbox and to extend its life moisture must be prevented from entering the gearbox and any moisture present in the oil must be removed from the oil on a continuous basis (condensation occurs continuously). Secondly in order to ensure that these preventative measures work and that no moisture is entering or is present in the oil, it must be checked on a continuous basis.

To achieve these objectives an Off Line filtration system with water removal capabilities is recommended. The fitment of an Air conditioner (breather fitted with filter and gel/desiccant) to remove moisture from incoming air is also a requirement. The gearboxes are closed systems with splash lubrication. The addition of an Off line unit will increase the amount of oil in circulation (which is generally a good thing). It will keep the oil dry and also remove any wear particles and dirt that might cause breakdown of the oil.

See the next page for an example of an Off Line Filtration unit with Water Absorption filter (white filter), with its circulation pump. Next to it are Air Conditioner units.

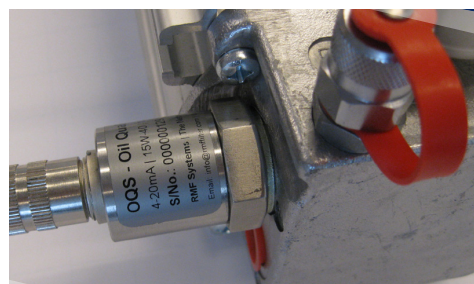
The Off Line unit is completely separate from the normal machine lubrication system. It draws oil from the lowest point in the gearbox sump, filters it and returns it to the gearbox.

The filter unit can be fitted with a heater element to ensure the oil temperature is always stable (which will improve gearbox lubrication efficiency) and ensure the oil is at the optimum temperature for water and contamination removal by the filters.



**Figure 3: Typical off line unit with water absorption filter and Air Conditioner**

Oil quality sensors require a representative oil sample to correctly assess the condition of the oil. As the gearbox uses splash lubrication there is no circulation of the oil. In order to get a representative sample the oil needs to be circulated past the sensor. The Off line filtration unit already circulates the oil thus provides an ideal position for the Oil Quality Sensor placement. The Off line unit is fitted with a special block for the Oil Quality Sensor installation



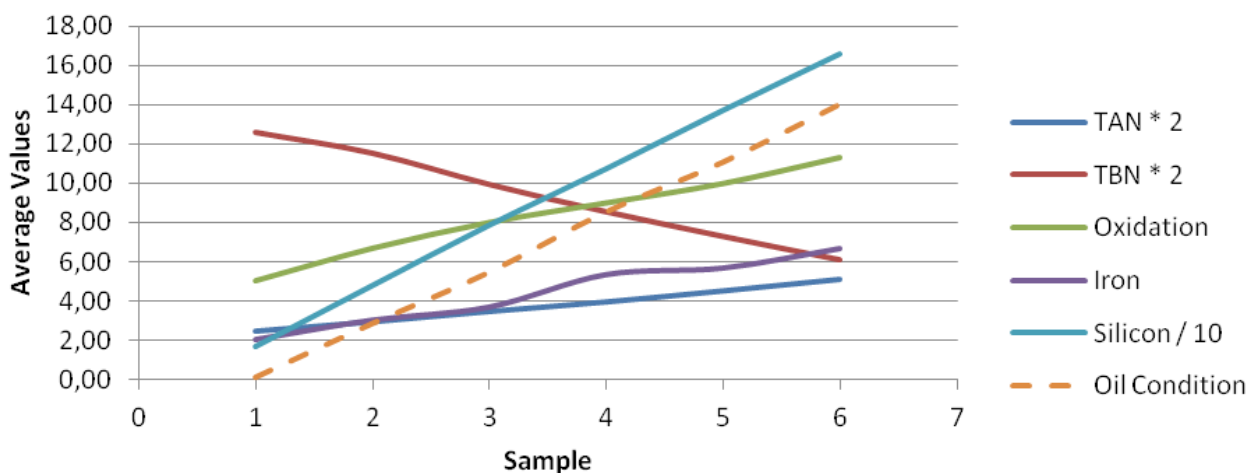
**Figure 4: Oil Quality Sensor and installation**

An Oil Quality Sensor is able to monitor the oil quality in real time. The oil quality sensor uses the base oil used in the gearbox as reference and determines the oil quality index. The OQS works in a similar way to dielectric sensors but measures both the capacitance and the conductance (a combined measure known as permittivity) of the oil. The combined data provides a reading that is much more accurate and sensitive to changes in the quality of the oil than other conventional methods. The permittivity is influenced by the following oil parameters. Oil viscosity, TAN, TBN, wear particles (Fe, Cu, etc.), contamination (Si, Moisture, NH3 etc.) and oxidation. Thus any change in any of

these parameters will influence the OQS output reading. The sensitivity of the sensor is 16ppm. The OQS takes oil temperature into consideration when calculating the oil quality.

The oil quality is expressed as an oil quality index number between 0 and 21. This is based on the loss factor, in other words how much of the original lubrication quality has been lost. Significant loss is above 25%, or 13 on the OQS index scale.

Below is a graph depicting the change in OQS index influenced by the change in oil parameters as confirmed by oil analysis samples taken at 100 hour intervals.



**Figure 5: Oil Quality Index trend compared with change in oil parameters**

Alarms can be set for a specific OQS index level (normally 13) as well as for a rate of change in the OQS value. Thus one is able to immediately shut down the machine should any parameter cause a rapid change in oil condition even before it reaches the set alarm level.

The OQS can be connected to a programmable local display unit or linked directly to the plant SCADA or control system. The OQS provides 2 values, the Oil Quality Index number and the Oil temperature.

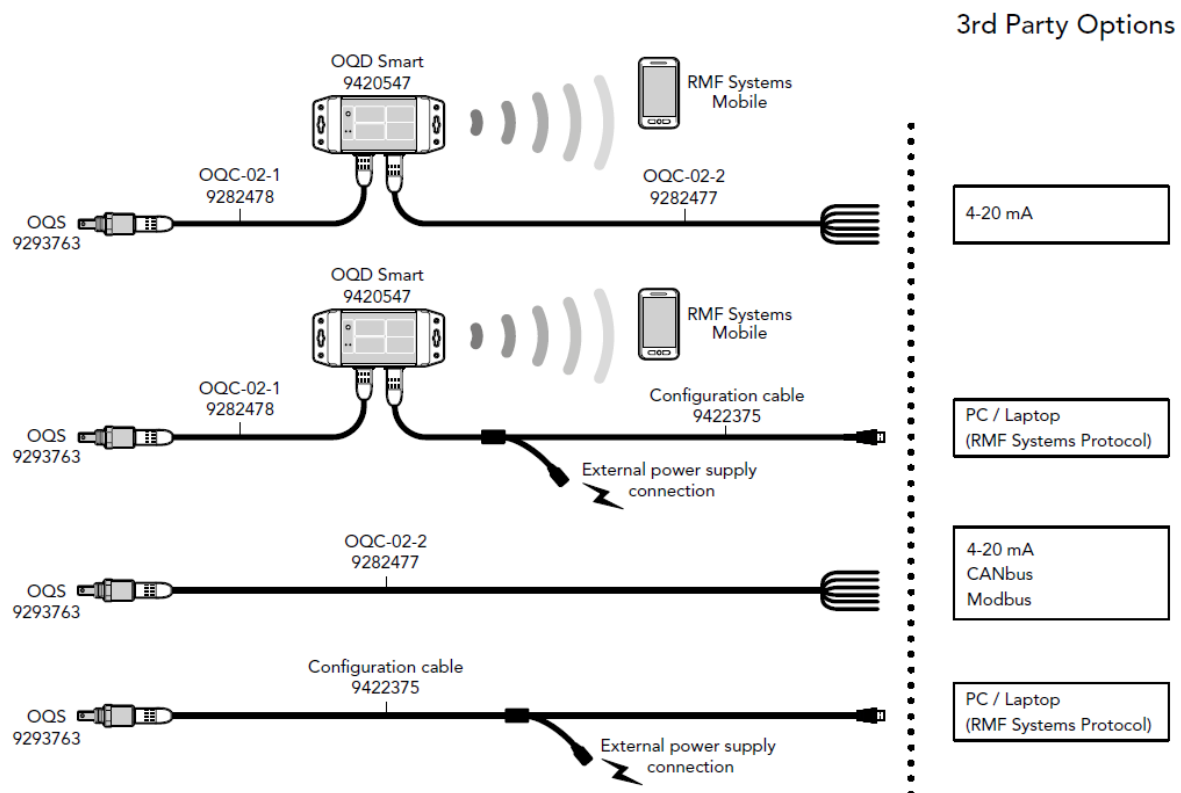
The Oil Quality history is saved by the optional Display unit and can be accessed via the various communication options.

The Display unit is also able to provide the data to a mobile device running the RMF Systems mobile software.

When used in conjunction with the Microsoft Windows based software RMF-View the data can be trended and presented in graphical format.

Please see the next page for the communication options.





**Figure 6: Oil Quality Sensor Communication options**

The Oil Quality Sensor is a cost effective sensor that is able to monitor the gearbox oil condition accurately in real-time. It is able to protect the gearbox from catastrophic failure caused by moisture in the lubrication oil by providing accurate and immediate indication of any change in lubrication oil caused by any contamination or wear.

The OQS saves money by providing an indication when oil need to be changed rather than on a fixed time basis (extending oil change intervals based on oil quality)



**Figure 7: Oil Quality Sensor and Display unit**

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### **Thus in summary:**

An Off Line filtration unit with water absorption filter (OLUW), an Air Conditioner and Oil Quality Sensor is the perfect solution for Spiral Freezer Gearbox protection, monitoring and life extension.

The air conditioner ensures moisture free clean air enters the gearbox, the filter removes all moisture and contamination from the oil while the Oil Quality Sensor provides

Real time, 24x7x365, accurate trending of the oil Quality

Shows the rate of change in oil quality over time

Responds to Dynamic Application like Stop/Start, Speed and Load

Responds to Dynamic Process changes like top-ups, total loss, additives, moisture and oil changes

**The OLUW and OQS combination is a simple, yet powerful and cost effective solution that provides peace of mind, while saving money.**