ACS
APPLIED COMPRESSION SYSTEMS
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TECHNICAL BULLETIN

ROTARY SCREW COMPRESSOR BEARING LIFE REDUCTION DUE TO WATER CONTAMINATION

INTRODUCTION

Typically, few bearings reach their theoretical life because some form of contamination usually causes wear or failure in advance. Contamination is a well-recognized problem in the air compressor industry as the rotary screw air end is basically an open system and it is practically impossible to prevent all contamination.

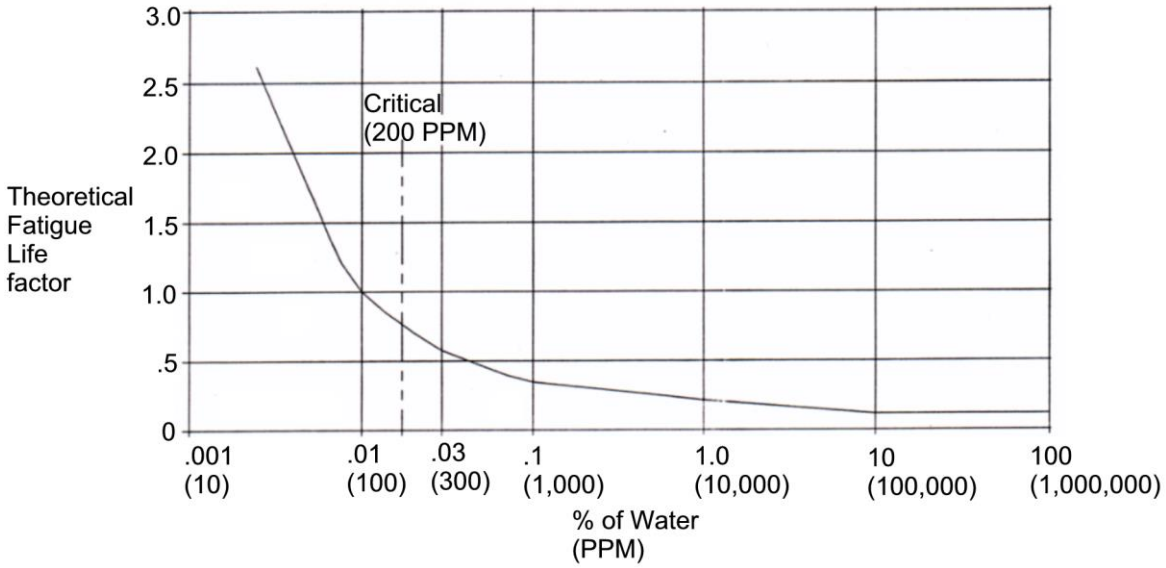
In general contamination can be either of two types, physical or chemical. Physical contamination is solid debris, from either foreign matter that migrates into the bearing through seals and filters, or internal particles from component wear. Chemical contamination is any liquid (mainly water) that finds its way into the bearings. Air compressors, by the very nature of the compression process, are highly susceptible to water and great care should be taken in early detection and minimizing water content in the oil.

One often seen fallacy is that the lubricant temperature in an oil flooded compressor should be as low as possible. This is incorrect!

Ideally an oil-injected rotary compressor should have the oil temperature maintained at around 180^0 F in order to prevent water vapor from condensing inside the compressor and contaminating the oil.

A thermostatic element in the range of 160 – 180^0 F is therefore best suited.

Water contamination takes the form of severe wear or early contact fatigue of the bearings. The attached chart identifies the result of experimental data generated by the major bearing supplier and clearly shows the accelerated reduction in theoretical fatigue.



BEARING LIFE REDUCTION DUE TO WATER CONTAMINATION IN OIL

Water will enter the compressor in one of several methods:

1. **Condensation:** Air compressors are particularly susceptible to this problem since water enters the compressor, (and therefore the lubricant) in the form of water vapor, which condenses inside the compressor.

2. **Heat Exchangers**: Corroded or leaky heat exchangers are common sources of water contamination in lubricating oils. In extreme cases, a rupture in the heat exchanger can cause massive amounts of water to enter the lubricant.

3. **Free Water Entry:** During oil changes or the addition of makeup fluid, water can be introduced to oil compartment. Condensation of water in storage containers is the most common origin of this water.

4. **Absorption:** Oil is hygroscopic to a certain extent, meaning it can absorb moisture directly from the air. The amount of moisture than can be absorbed is influenced by the relative humidity of the air and the saturation point of water solubility in the oil. Depending on temperature and pressure, this solubility limit will vary from about 100 PPM for low additive oil to several thousand PPM for high additive and certain synthetic oils. For any given water-in-oil saturation point and relative humidity of ambient air, an equilibrium will eventually be attained where the moisture moving from the air to the oil, and also from the oil to the air, is equal. Absorbed water is always dissolved in the oil at first, but may later, due to temperature/pressure changes, be condensed out to a free or emulsified state.

Toll Free (855) 417-2396
Fax (250) 417-3183
info@appliedcompression.com

CANADIAN ADDRESS
400 Industrial Road A
Cranbrook, BC V1C 4Z3

U.S. ADDRESS
PO Box 111
Eastport, ID 83826