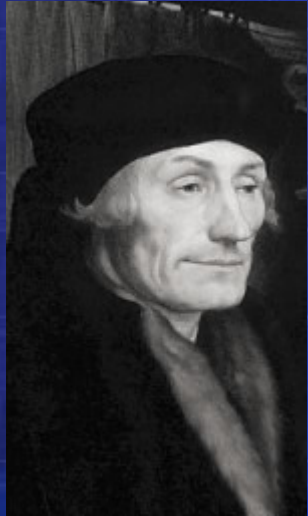


General Quotes...

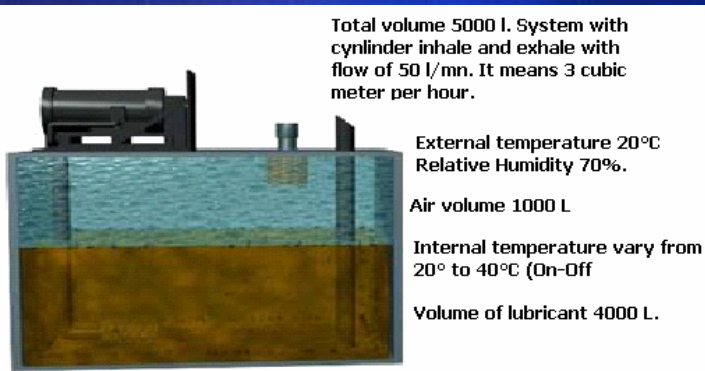
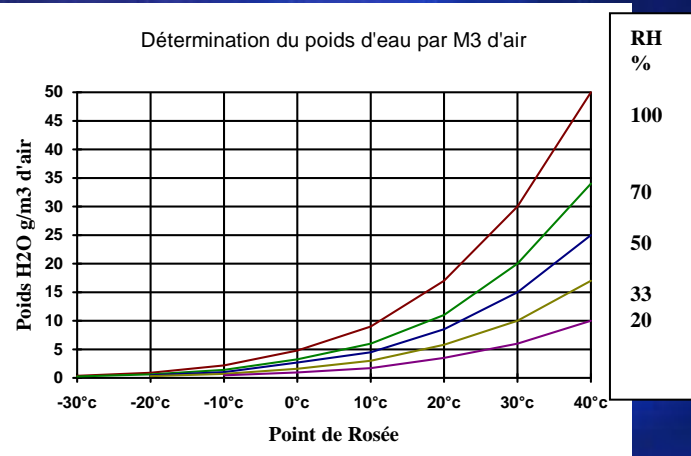
Contamination is the greatest single cause of lubricant malfunction and subsequent excessive wear of parts – (Mobil Oil)

Prevention is better than cure. –Desiderius Erasmus

- Were you aware that more than 75 percent of hydraulic system failures result from contaminated fluid (caused by particulate and water introduction through the breather cap)?
- Did you know that lubrication failure is the #1 reason for gearbox returns during the warranty period?
- According to SKF, "It is well-known that free water in lubricating oil decreases the life of rolling element bearings by ten to more than a hundred times. ." . 90% of bearings did not reach 10% of optimal calculated L10.
- More than 70% of oil or lubricant did not reach 50% of their optimal duration.
- With clean and “dry” high quality lubricants, energy consumption may decrease by 20% (carbon dioxide (CO₂) + Nitrogen oxide (NO_x) emission decrease).
- How about the fact that industry spends upwards of \$240 billion annually (established by the MIT, just for USA) fighting the problem of mechanical wear occurring as a result of contamination?
- And, were you aware that the most common cause cited for denial of warranty claims in hydraulic systems is contamination?



Cause and Explanation of Condensation



- Ambient air usually varies between **10 and 40°C** (night-day temperature variations)
- Inside reservoirs, or gearboxes, internal temperatures vary from **10°C to 50°C-90°C** (On-Off of functions + application variations).
- Curves show that internal air >40°C keeps and retains water vapour for a minimum of 50g per cubic meter of air.
- When the internal air reaches the “saturation” or equilibrium point (50g of water vapour per cubic meter of air at an internal temperature of 40°C), each new gram of water vapour inhaled by the reservoir will be exhaled.
- When the lubricated system is OFF, the internal temperature will decrease to match the external temperature of the air.
- Now, with the air only able to contain 15 g of water vapour at 20°C, 35g of water vapour per cubic meter of air will turn in free water (condensation).

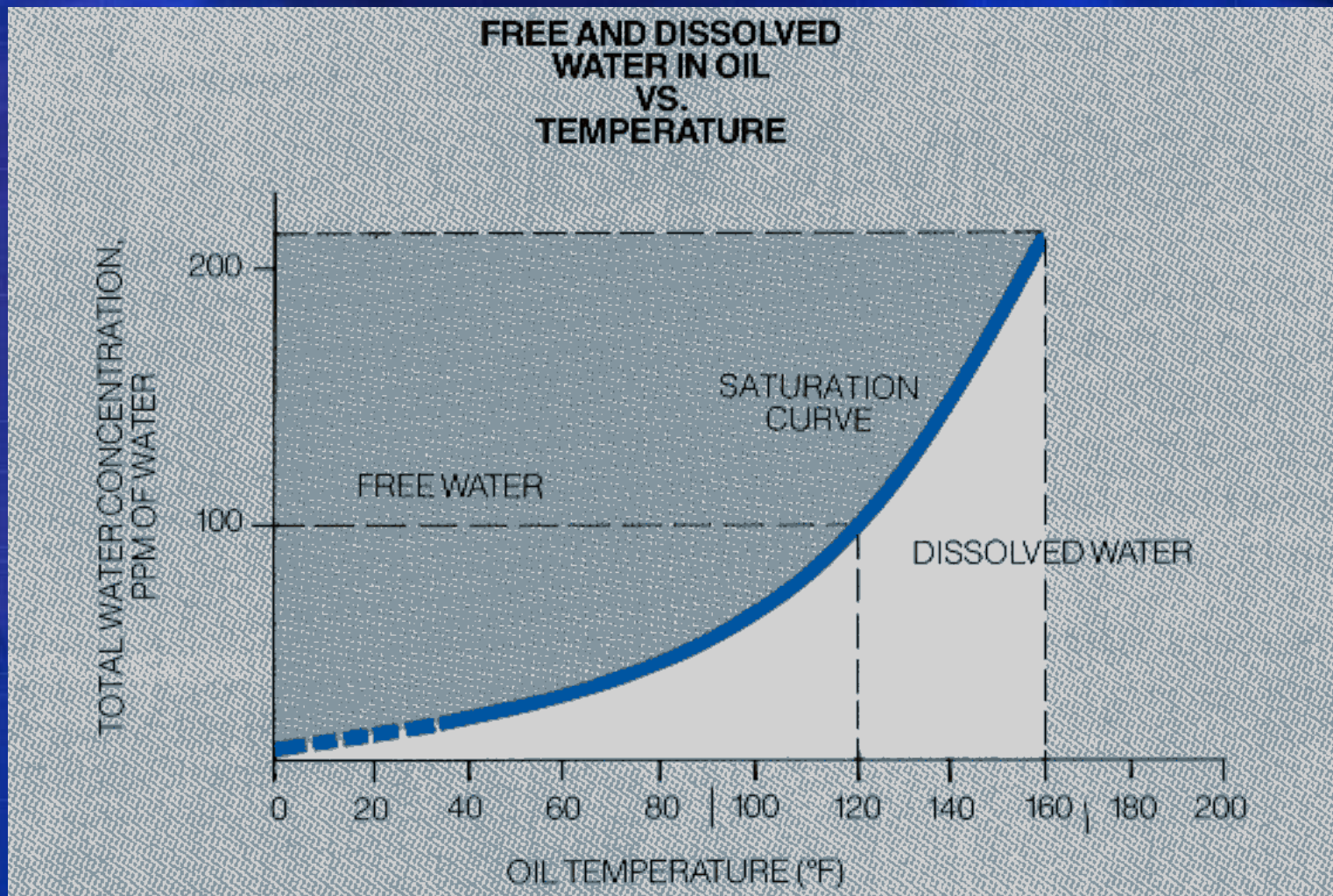
Cause and Explanation of Condensation

Condensation does not depend of external relative humidity

- At an ambient humidity of 20% at 20°C, air contains 5g water vapour per cubic meter. To reach equilibrium and 50 g of water vapour per cubic meter, it is necessary for a system to “inhale” 10 cubic meters. This will take less than 4 hours.
- At an ambient humidity of 50% at 20°C, air contains 10 g water vapour per cubic meter. To reach equilibrium, 5 cubic meters will be necessary. This will take less than 2 hours.
- At an ambient humidity of 100% at 20°C, air contains 15 g of water vapour per cubic meter. To reach equilibrium, 3 cubic meters will be necessary. This will take about 1 hour.

So, in any case, after 1, 2 or 4 hours, 1 cubic meter of air will contain 50 g of water at 40°C. When internal temperature will reach 20°C there will be condensation of 35 g of water.

WATER SATURATION CURVE



States of water in Oil

- **DISSOLVED WATER** - Oil appears bright and clear. Difficult to separate.



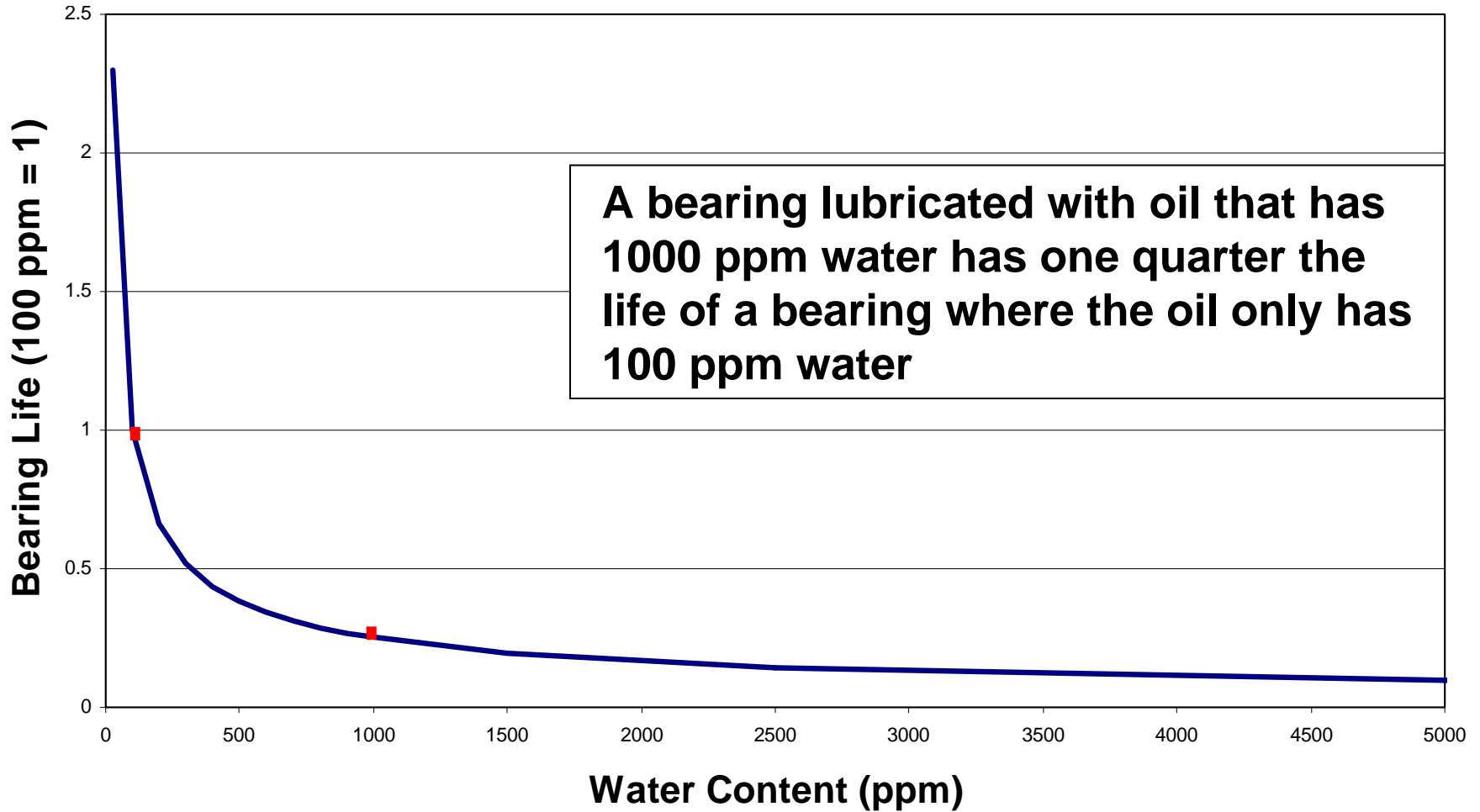
- **EMULSIFIED WATER** - Very small droplets dispersed in oil. Oil viscosity may go UP (like mayonnaise). Tiny amounts of detergent engine oil can contaminate industrial oils.



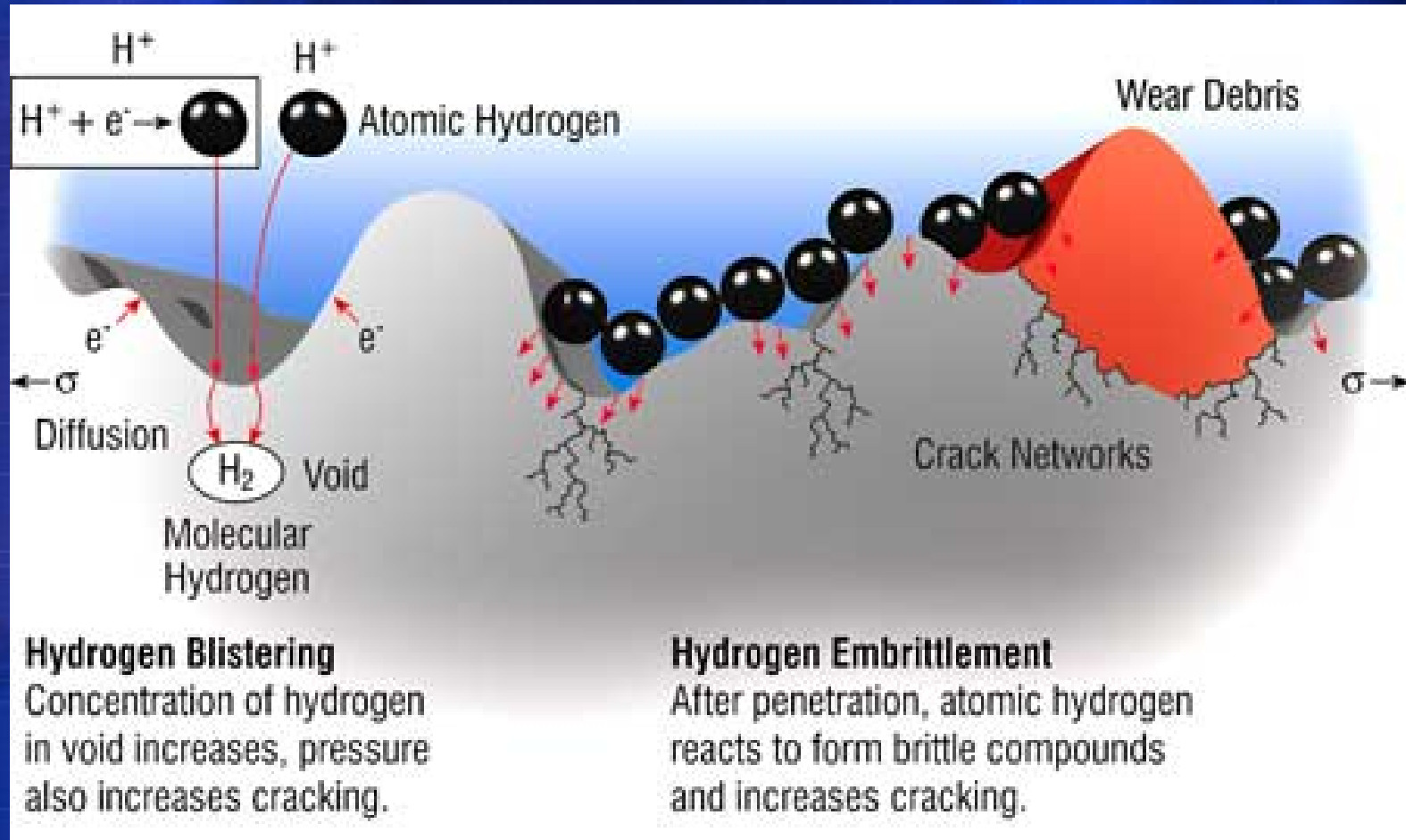
- **FREE WATER** – Large drops that readily settle out.



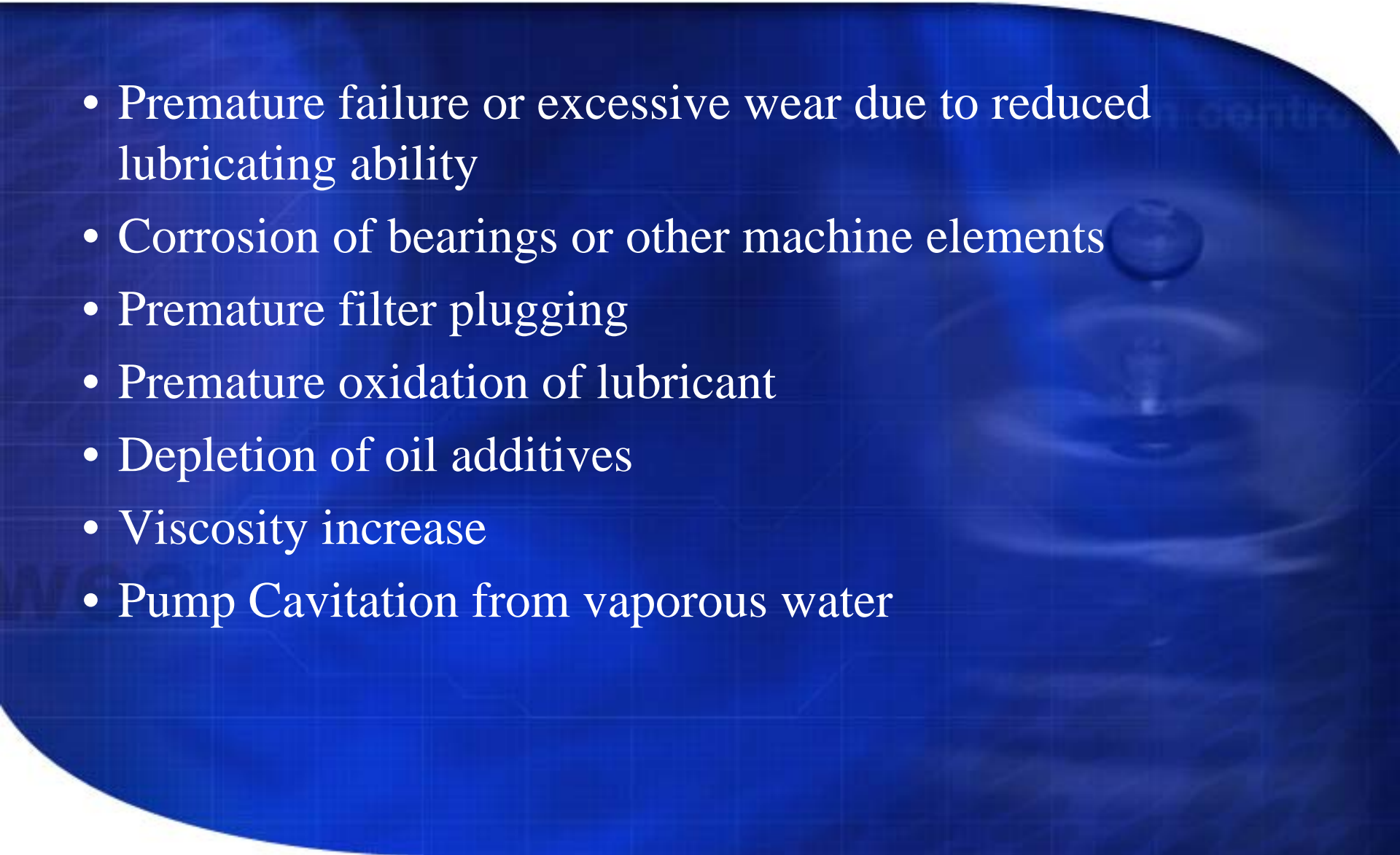
EFFECT OF WATER ON BEARING LIFE



CHEMICAL REACTIONS BETWEEN OIL, WATER AND STEEL SURFACES



WATER CONTAMINATION SYMPTOMS

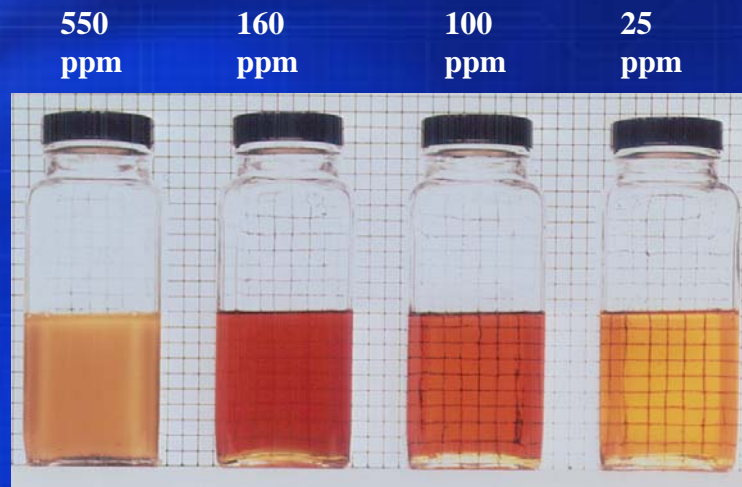
- Premature failure or excessive wear due to reduced lubricating ability
 - Corrosion of bearings or other machine elements
 - Premature filter plugging
 - Premature oxidation of lubricant
 - Depletion of oil additives
 - Viscosity increase
 - Pump Cavitation from vaporous water
- 

ACCEPTABLE LEVELS OF WATER

- Research indicates that very small amounts of water reduce bearing life
- For turbine oil systems ASTM D4378 In-Service Monitoring Guideline lists 0.2% (2000 ppm) as maximum
- SKF recommends maximum of .02% (200 ppm) for bearings
- Best practice is to maintain lowest level practical below saturation point

TYPICAL SATURATION POINTS

- Hydraulic - 200-400 ppm (.02-.04%)
- Lubrication - 200-750 ppm (.02-.075%)
- Transformer - 30-50 ppm (.003-.005%)



BREATHERS ARE PART OF THE SOLUTION



Breathers, as part of a reliability centered maintenance plan, can help extend equipment life exponentially!

HOW MUCH WATER IS TOO MUCH?

Current Moisture Level

Life Extension Factor

ppm	2	3	4	5	6	7	8	9	10
50000	12500	6500	4500	3125	2500	2000	1500	1000	782
25000	6250	3250	2250	1563	1250	1000	750	500	391
10000	2500	1300	900	625	500	400	300	200	156
5000	1250	650	450	313	250	200	150	100	78
2500	625	325	225	156	125	100	75	50	39
1000	250	130	90	63	50	40	30	20	16
500	125	65	45	31	25	20	15	10	8
250	63	33	23	16	13	10	8	5	4
100	25	13	9	6	5	4	3	2	2

Estimated life extension for mechanical systems utilizing mineral-based fluids.

Example: By reducing average fluid moisture levels from 2500 ppm to 156 ppm machine life (MTBF) is extended by a factor of 5.

Where to use Desiccant Breathers

- Hydraulic systems
- Gearboxes
- Pumps
- Bearing circulating systems
- Process tanks
- Storage vessels
- Fuel tanks
- All types of reservoirs