



Course: HNC Process Operations Engineering Year 1
Module Code: PCEE4002/PCPo4002
Module Name: Research, Study and Presentation Skills
Element 1. A literature review

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Introduction

During this literacy review three separate articles will be evaluated and compared for similarities, differences and information reviewed from each article. The three separate articles are located within the same source 'IOSH Magazine'. IOSH, Institution of Occupational Safety and Health, is a company that focuses on the health and safety of professionals working in a diverse range of operations and roles. The sources here were all taken from IOSH's own official magazine that provides the latest news and insight in to the safety and health profession.

The aim of this literacy review will be to determine and argue points about human reactions amongst health and safety, and whether or not human reaction to environmental stimulus such as an emergency can be controlled or predicted.

The chosen articles for this assessment are as follows;

Crisis Response- Good in a Storm.

Human Error: Error on Trial.

Piper Alpha: Regime Changer.

Along with the chosen articles this review will also utilise points and evidence from a documentary on the Piper Alpha incident of July 1988.

Literature Review

When first evaluating these articles, I read and made notes on all of the articles to ensure major points would be saved in order to be evaluated. This will begin by analysing individual articles before comparing and evaluating. The first article to be analysed will be the article Crisis Response – Good in a Storm. This article begins by informing the reader of facts from the Iraqi War, specifically the pedestrian casualties ‘During Iraqi missile attacks on Israel during the Gulf War in 1991, an estimated 70% of Israeli civilian hospital admissions were a direct result of behaviour ill-matched to the incident. People were injured as a result of running into doors or suffocating because they had not opened the filters on their respirators.’ This is a quick introduction in the ideology of the piece expressing that humans portray impaired abilities whilst coping within an emergency situation.

The piece then begins to write about the loss of initiative, briefly this is known as an inability to think or plan as response to danger. This piece is then supported with a quote from a survivor from the MV Estonia that sank in Finland 1994 and lost 852 Souls, this survivor is quoted as claiming *“I didn’t think. Shock is so disorienting it doesn’t allow us to think clearly.”*. This claim is further supported by information gained from the Piper Alpha disaster in 1988 stating that many of the men whom lost their lives made no attempt to leave the platform. Stereotypy was then the next subheading on the piece, stereotypy is described as humans reacting to emergency situations by resorting to last known actions or acting purely through impulse rather than being able to think of or even comprehend suitable lifesaving actions. The description is then followed by quotes once again supporting the before mentioned actions, *‘During the 2001 attack on the World Trade Centre in New York a woman is reported as having broken away from her group saying that she was returning to fetch her bag – she perished; one man returned to get his mobile telephone while another wanted to return to collect his minidisk player.’*. This quote above evokes a response from the reader questioning why anyone would put their life in danger for such trivial item. This article is an informative piece that is backed by many different sources, it is clear that it is meant for readers that desire to learn from the text.

The article based on Piper Alpha published 25th June 2018 is the second of the sources will be reviewed, this piece is an informative piece meant to inform the readers on what, why and an idea on how the Piper Alpha disaster came to fruition. It begins by describing the rig, placement and ability. We first learn that the rig is position in the *‘North Sea between the Orkney Islands and the Norwegian coast’*, we then gain some idea of the quantity of oil that is pumped on a daily basis along with a basis of the sheer size. After a short introduction the piece begins to focus on the disaster and the actions that allowed such an incident to occur. This piece is written differently compared to the previous article, by covering the aspects of the disaster in an orderly fashion, listing the chain of events from start to finish of the initial root causes to the final moments. This is in contrast to the previous article that was filled with various examples to support points previously made. The Piper Alpha article is an informative piece focused entirely on this particular disaster without the intention of persuading a verdict of the root cause or reason that lead to the failure.

The article starts the main body of text by informing the readers that the owners of the rig at the time 'Occidental' that the platform had not been shut down due to Occidental believing that the safety regulations in place would have been adequate, this statement evokes an immediate response from the reader to initially blame Occidental however as the article reads on the judgement shifts between a few root causes that added together to create the failure. Continuing, On the 6th of July a pressure valve was removed from one of the two compression pumps located on the rig, this was removed for yearly recalibration and was replaced by a hand tightened plate. This is the first red flag that comes jumping out whilst reading this article as a hand tightened flange should never be utilized especially on a pump. The next paragraph states that after a shift change the now only fully operational pump has failed. The spare pump that should be currently marked offline, was then issued for work and restarted. Causing a slow release of condensate gas. This gas leak was continuing undetected until 22:00 hrs when gas alarms were raised seconds before the initial explosion. The explosion had damaged the platform structure and smoke from this would affect the removal of personal via the helicopter platform. As per emergency procedure the crew gathered at the muster point at the top of the accommodation complex, all personal were located here other than essential personal such as operators that were required to help with the emergency situation.

20 minutes after this point a secondary explosion occurred from pipelines around the rig. A further 50 minutes after this a third explosion erupted from the pipeline to MCP-O1 gas processing platform that resulted in a 150-metre fireball that engulfed the rig, by 23:30 a mere hour and half after the initial explosion the structure of the rig began to sag due to the heat, however all employees were still on board at this point as many were still awaiting in the muster point for rescue, a rescue which was never to come. 61 of the 226 personals on board made their own way down to the lowest parts of the rigs before jumping in to the sea to eventually be collected by rescue boats. The most common cause of death was found to be smoke inhalation causing asphyxiation.

Error on trial is an informative piece designed for professional personal in order to change outlooks to tackle health and safety disasters and incidents. It begins by talking about management attributing failures to personal and end users which is claimed as not the case. This article is based on exposing errors further up the corporation ladder that are being taken through causing failures on the end user. This point is showed through the use of the 'Swiss cheese model' quotation, *'James Reason's "Swiss cheese" model shows holes (failings) in layers of protection at the managerial level, which let an accident trajectory through these "slices" so, when the end user performs an unsafe act, an accident occurs.'* The piece then continues to argue about the inevitability of accidents within the work place and that the idea of completely irradiating any form of incident is an implausible task.

The article is based around attributing errors to human behaviour be it from the top manager or the workers on the shop floor, it does this by categorising human error. This data is received from Jens Rasmussen's paper 'Human Errors: Journal of Occupational Accidents' written in 1982, this paper defines three categories that could be subject to errors, Skill-based, Rule-based, Knowledge-based. Skill-based

talks about more or less subconscious routine work that is controlled by patterns of repetitive behaviour. Errors are related to the variability of the task. Rule-based is aimed around errors that occur around the wrong classification of the situation or a failure to recognise that specific rules should be applied. Knowledge-based remarks errors that occur in unfamiliar environment. The article also focusses on the error proneness of individual characteristics attributing to accidents within the workplace. Aggression, this predisposes people that will be unwilling to deal with frustrations which is associated with obeying simple health and safety rules. Anxiety can result in obsessive disorders such as checking actions multiple times and a lower tolerance to danger, this may cause interruptions in process flows. Extroversion and introversion, these terms apply to two different characteristics of people that may either seek out danger and those who are less capable to deal in high pressure situations. Impulsiveness is a characteristic of people who may be able to react faster but less accurately than others.

In conclusion all of the pieces of literature respond to the same subject in different ways, all are written in the form for passing knowledge aimed at professionals or those with an interest in health and safety. This is also shown in the fact that all articles are posted from specific health and safety focused business. Crisis response in an informative piece backed up by a number of quoted facts from various scenarios to add to the points being made. Piper alpha is a piece written to display the facts of one specific event allowing the reader to develop their own idea of what the root cause of the issue was. Along with this the piece also addresses behaviours of personal onboard the rig during the event. Error on trial is designed to challenge the idea that accidents and incidents within employment will ever be completely removed. This piece shows how the events may be caused by a variety of sources from the employees on the ground to the managers implementing rules and work deadlines. In my opinion accidents within work will never and can never be completely removed, human nature will always allow some form of error and accidents are a part of a human lifestyle. However, with competent and repetitive training and procedures employers and employees will reduce and control the accidents that may occur. As with the case of Piper Alpha a missing piece of information to state that the specific valve was out of service allowed the rig and many lives to be lost. This was both procedure and human errors and should not have been able to happen with the correct system in place. In the event that one of the variables were removed from this equation the outcome would have been much different and the disaster could have been avoided.

Word Count: 1589

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<https://www.youtube.com/watch?v=Nwbw5PHZnqk>

Piper Alpha documentary.

Date
Viewed.



OIL DEGRADATION

Report

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105796

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Introduction

This report will be written on oil degradation and contain information on different causes and ways to minimise the amount of oil degradation within an oil-based lubrication system as used on pumps and turbines and other plant equipment. This report will contain knowledge and findings based upon experience within the field as well as research carried out for this specific subject. All material used will be referenced at the end of the report.

Report

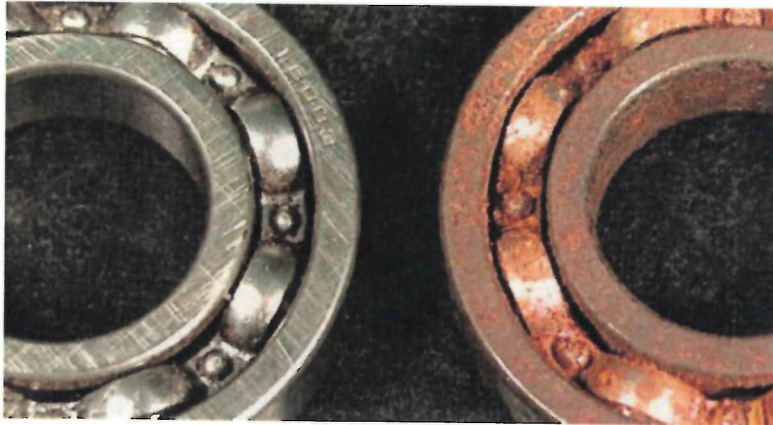
Introduction

The deformation of oil will affect any mechanical equipment that utilises an oil-based lubrication system, this lubricant is essential to ensure the equipment is capable of continuing for its full lifespan and work efficiently. This report will cover and explain the main common causes of oil degradation such as, contamination, oxidation, thermal breakdown, micro-dieseling, additive depletion, and electrostatic spark discharge. Once these basic causes have been addressed the report will then continue and provide ways in which oil degradation can be limited and the lifespan of oil based lubricants can be increased.

Deformation of oil is a huge issue within an industrial scenario due to the time loss of replacing or repairing affected equipment. This downtime will not only cause a reduction of efficiency or product numbers but also cause cost increases due to money for repair components as well as wages for maintenance personal to carry out the tasks.

Causes

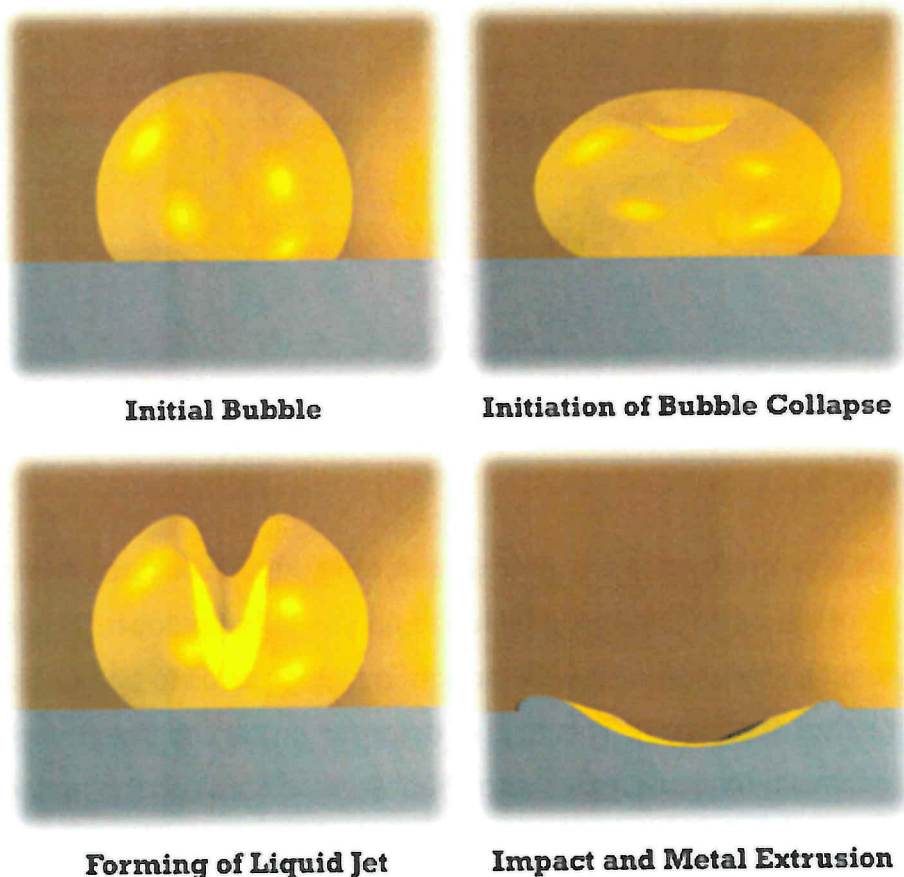
Types of deformation, Oxidation is the first type of oil degradation that will be discussed, oxidation is the reaction of materials or components with oxygen. This increase in oxygen can cause multiple side effects including viscosity increase formation of a varnish, emulsion sludge and sediment formations, additive depletion, acid specification increase along with rust and corrosion increase. Oxidation will decrease the lifespan of a lubrication oil dramatically. The image below shows the effect of oxidation on a bearing compared to a new unit.



(FIG 1 Oxidation in bearings)

Thermal breakdown is a type of oil deformation, this occurs when the temperature of the oil becomes too high and begins to breakdown. This is most commonly caused by a low oil level therefore causing the oil to be unable to remove the heat from the application. This type of deformation can be determined due to the fact that it causes a blue or purple 'burnished' surface finish on the material. Thermal breakdown is similar in comparison to micro-dieseling, this type of oil degradation also sees higher temperatures but also creates larger carbon deposits and is capable of damaging the material in the form of extrusions of the material known as cavitation. These extrusions if located on a rotating piece of equipment or in any situation in which it creates contact with another surface will quickly multiply the damage causing irreversible affects to equipment and process.

Cavitation

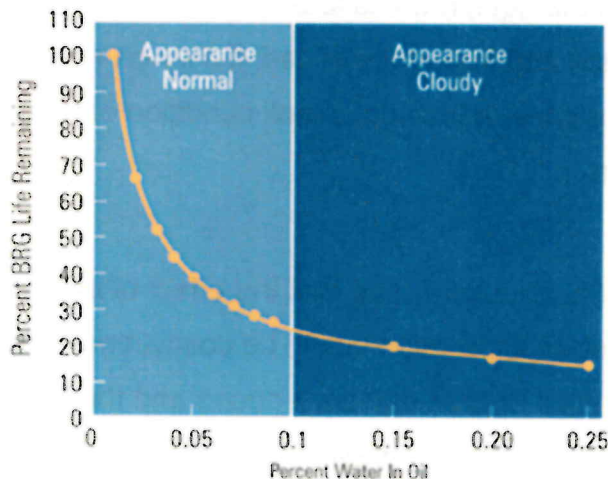


(figure 2. Micro-dieseling)

Electrostatic spark discharge is an event that can occur within a lubrication system in certain circumstances, this is described as *"When clean, dry oil rapidly flows through tight clearances, internal (molecular level) friction within the oil can generate static electricity and may accumulate to the point where it produces a sudden discharge or spark. These sparks are estimated to be between 10,000°C and 20,000°C and typically occur in mechanical filters"* (<https://www.machinerylubrication.com/Read/989/fluid-degradation-causes-02/01/2020>). This type of degradation is commonly known as lightning damage and leaves behind small pin like damage to the surface of components that it grounds too. This effect can be negated with a good earth system within or directly connected to the oil system to reduce this static build up.

Finally the last cause of oil degradation that will be covered is the most common cause within any application, this is contamination. Contamination means the introduction of any foreign bodies that should not be within the system gaining

access, this may be in the case of excess oxygen, water, dust particles, etc. This will drastically reduce the life span of an oil and equipment that's is dependent on this lubrication system. Water is the most common type of contamination within oil lubrication systems be it gaining access through faulty gaskets, plugs, covers, operator error or damage to the equipment such as a crack. The image below shows the severity of allowing water inside an oil system and its effect on the lifespan of the oil.



(Figure 3 – water contamination against oil lifespan)

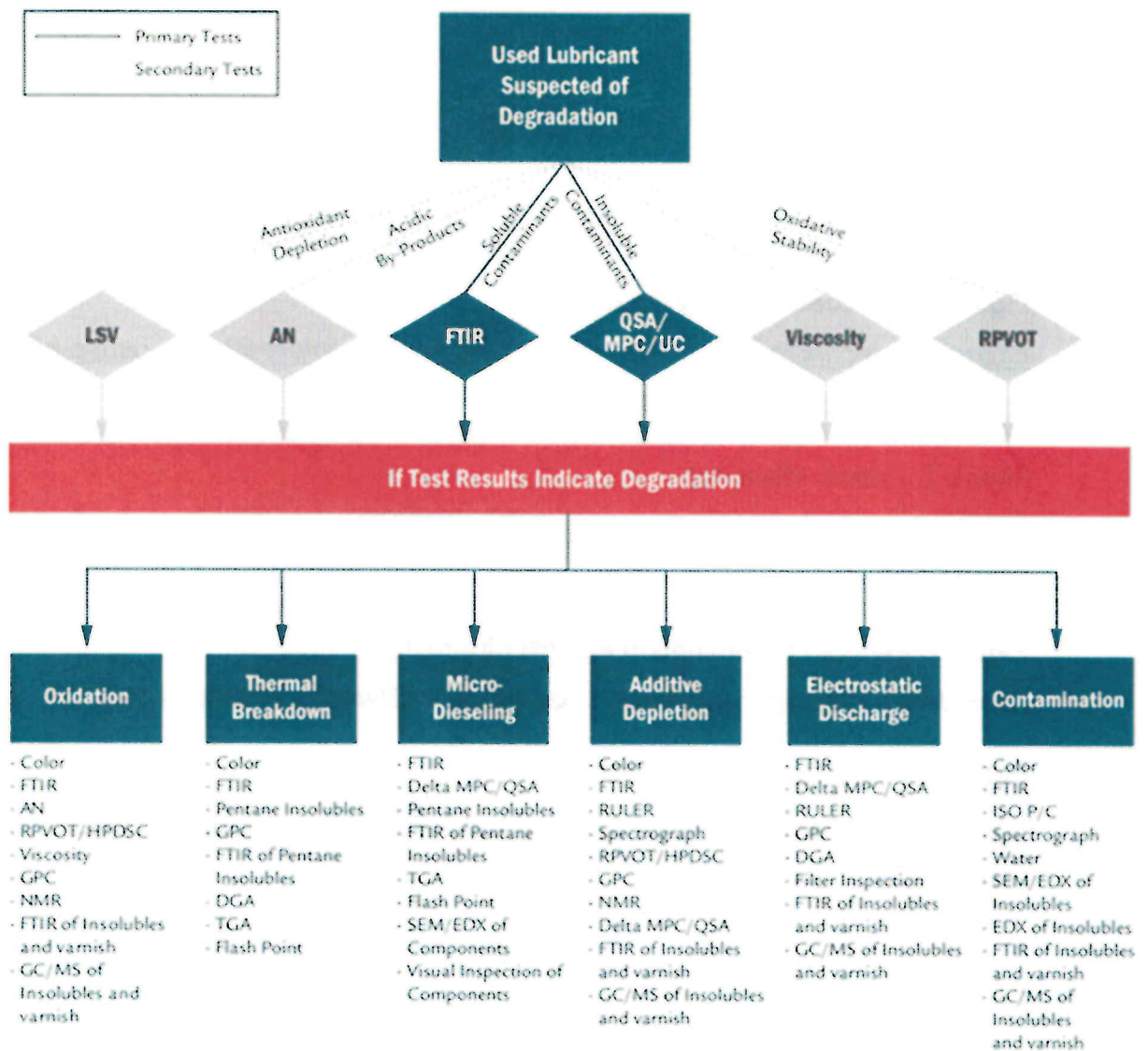
As the image above shows water contamination in oil will cause a dramatic effect creating downtime for possibly costly repairs if gone unnoticed. As little as 1% of water in oil will reduce the lifespan expectancy of an oil lubricated bearing by as much as 90%. *"In a lubricating system, the two most harmful phases are free and emulsified water. In [journal bearings](https://www.machinerylubrication.com/Read/192/water-contaminant-oil) for example, the incompressibility of water relative to oil can result in a loss of the hydrodynamic oil film that in turn leads to excessive wear."* (<https://www.machinerylubrication.com/Read/192/water-contaminant-oil>, 06/01/2020) Although it is possible to see when water has come into contamination with water, as the oil turns cloudy and begins to form as an emulsion, at this state it is too late for the oil to be recovered and could have already caused damage to the equipment.

Degradation will always occur within oils especially within a high use system such as an industrial use or motor vehicle. There is no way to entirely stop this from occurring, however much can be done to reduce the amount of degradation occurring within the oil lubrications systems. In order to decide on an action to be

taken the type of oil degradation must first be recognised, only then a suitable prevention can be put into place. The most common prevention method that is used within any area that depends on oil as a lubrication for machinery is a service schedule. A service schedule will be recommended from the supplier of any mechanical equipment detailing the intervals between services and what actions should be carried out. These suggestions should always be followed and adhered too. These actions may include regular oil level checks and draining of water that has built up within the oil every time the equipment is to be used. After a period of months, dependant on the application and frequency of use, it may be necessary to replace gaskets, drain and clean sumps or housings, check condition of bearings and replace perishable components.

Conclusion

In conclusion to this report, it is obvious to see that the effect of oil lubrication and its mistreatment within an industrial application would be costly, time consuming and highly ineffective. However most oil failures can be reduced and the life span of that lubrication oil can be increased therefore decreasing the frequency in which it is necessary to service equipment allowing for longer runtimes with less monetary loss. Being able to identify the type of oil degradation that is occurring suitable countermeasures may be applied. Flow charts such as the one pictured below can aid in determining the cause and effect of oil degradation within specific circumstances.



(figure 4 – degradation flow chart)

By following this chart the type of degradation can be determined, cause can be evaluated and corrective actions put in place.

Bibliography

Figure 1 – Oxidation in bearings - -

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Figure 2 – micro dieseling -

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30/12/2019

Figure 3 - water contamination against oil lifespan -

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Figure 4 - degradation flow chart

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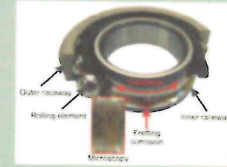
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OIL DEGRADATION

Tom
Haines

FAILED BEARINGS

Causes downtime for repair
Causes process issues
Money lost for downtime and
product production



MEANING

Degradation *noun* (DESTRUCTION)

The process in which the beauty or quality of something is destroyed or spoiled:

CAUSES

Oxidation
Thermal Breakdown
Micro-dieseling
Electrostatic Spark Discharge
Contamination

FOCUSING ON LUBRICATION DEGRADATION

This presentation will focus on lubrication degradation, mainly bearing lubrication in pumps and turbines.

OXIDATION

Reaction of lubricant with oxygen.

Can cause increase in:
viscosity increase,
varnish formation,
sludge and sediment formation,
additive depletion,
base oil breakdown,
filter plugging,
loss in foam properties,
acid number increase,
rust and corrosion.



THERMAL BREAKDOWN

Temperature of the lubricant getting too high

- Can vaporise the light ends causing:
- Increased viscosity
- Removal of additives
- Produces gases
- Produces insoluble by-products



CONTAMINATION

Foreign objects and substances

Metals such as copper and iron speed up degradation acting as a catalyst

Water and air provide oxygen causing oxidation



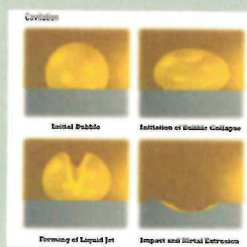
MICRO DIESELING

Also Known as Pressure-Induced thermal degradation

Same effects as thermal breakdown with more carbon deposits and cavitation

Caused by air bubbles moving from low-pressure to high-pressure resulting in adiabatic compression.

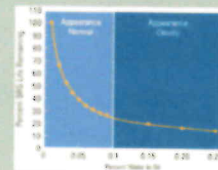
Increase in pressure – increase in temperature



CONTAMINATION EFFECT

As little as one percent water in oil can reduce the life expectancy of a bearing by as much as 90%

Reduced to half life expectancy after 0.04%



ELECTROSTATIC SPARK DISCHARGE

Also known as Lightning Damage

Clean oil rapidly flowing through tight gaps develops electrical charge

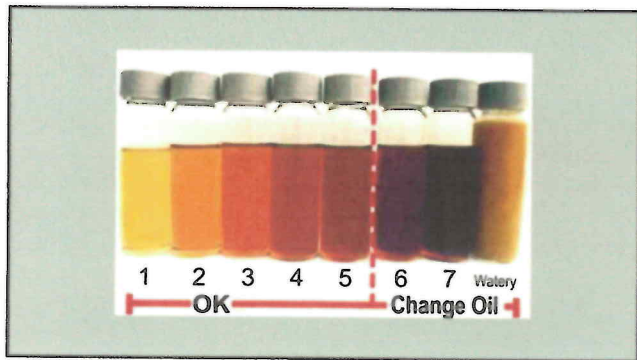
Sparks generated are between 10,000°C – 30,000°C

Typically occur in mechanical filters



PREVENTION

- Correct lubricant for service
- Correct additives
- Warm up to correct temperature before heavy use
- Regular servicing
- Clean inside and out
- Well fitting covers and gaskets
- Earthed
- Monitor temperatures
- Sensory checks



ANY QUESTIONS?

Oil degradation and life-term

Oil degradation is a general term used to describe the destructive mechanisms that cause physical and chemical changes to compressor fluids while in service

General oil care is of the utmost importance in ensuring good life expectancy and maintaining equipment condition.

Causes of degradation

Oxidation

Thermal Breakdown

Micro dieseling

Additive Depletion

Contamination

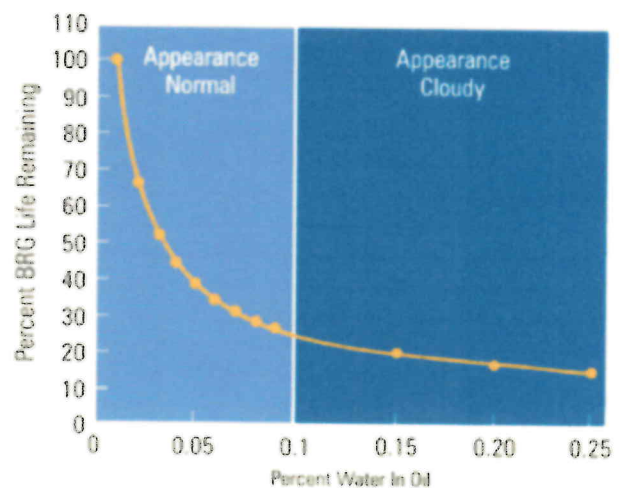
Electrostatic Spark Discharge

Contamination



Bearing showing water damage

As little as one percent water in oil can reduce the life expectancy of a bearing by as much as 90 percent.



Word search

E T W K T G S B Z R E K F W O W T I R W
Z R I D K T H O E Y C X S F N D L N R X
V A Z D E I V D R N I Z A U C V T M A N
W X Y N Z D S X J G T K A E P E P I S I
S G D M P K K J G A A N M U N B Q F X V
R Z S C E G Z F P C T O K W W F P N R K
E Z G O N N V U Y U S I W W X R M O R M
T N X N C I K W A F O T S G W D G I W E
L K L T Y L T U U Z R A R A K G P T A V
I X J A Q E V C R T T C Z G Y W Z A P I
F N L M P S F H Q G C I B H N T E D J T
J O X I P E C Z Q R E F H T Y S X A Q I
L I M N O I S Z E J L I P Q H G U R U D
A T C A C D O M C O E C O S J Q Y G R D
M A S T H O S T Y Q S E W Z P P H E K A
R D G I E R E R E G Y P P I T C W D R S
E I N O I C V U P B N S G E D Z V Q N O
H X W N B I E A J H Z S S I H J Y J Z T
T O O Q F M A A L U F Q U M P B Y Q E J
V G T V B Y O Q Z G H M C W Y L E Y P D

OIL
OXIDATION
DEGRADATION
CONTAMINATION
MICRODIESELING
THERMAL
ADDITIVE
ELECTROSTATIC
SPECIFICATION
FILTERS

