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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

The purpose of this assignment is to review a series of literary articles that all discuss human error, effects and causes in different ways using different examples and focal points. These articles are all taken from the Institution of Occupational Health and Safety monthly magazine. Article 1. Title - Crisis response: Good in a storm. This article investigates human responses to a crisis and how, under pressure, incorrect decisions may be taken. Article 2. Title - Human error: Error on trial. This article investigates human error: Can it be eliminated or accepted as an essential part of human activity? Article 3. Title - Piper Alpha: Regime change. The article looks at the Piper Alpha incident and the human failings that were the root cause of the disaster. All three articles investigate issues associated with the response of humans when faced with a potentially life threatening situation.

Literature Review

Read, analyse, evaluate and compare the three articles to determine the following:

- Common threads that run through the three articles. Identify where commonalities exist.
- The message the articles contain and the demographic they are aimed at.
- How the arguments are presented, for example, are the articles informing, persuading, advising or purely entertaining?
- Do they successfully resolve the questions that have been raised?

this is part of the question!

Crisis Response- Good in a Storm.

Crisis Response- Good in a Storm is an article written to inform people about the effects an unfolding disaster will have on a person's behaviour. The article refers to many disasters in which the unfortunate people caught in the disaster act in ways that are not planned or instructed. This article comments highly on cognitive behaviour in incidents and how the sudden shock of a traumatic event will affect the choices made and the actions taken in response to unfolding events. When tackling the behaviour, the article splits the behaviour into the following categories:

- Loss of initiative

This section comments on the loss of the cognitive function to process the unfolding events and use initiative to survive in these events by commenting on a number of examples that prove the survivors of the event have failed to use their initiative and think clearly about what is happening. For example, the article uses this quote from a survivor of "ferry MV Estonia that sank off Finland in 1994 with the loss of 852 lives, said: 'I didn't think. Shock is so disorienting it doesn't allow us to think clearly'." (J. Leach 2018 Crisis Response- Good in a Storm IOSH Magazines viewed 11/11/19 <https://www.ioshmagazine.com/article/good-storm>)

- Stereotypy

The subsection titled "stereotypy" comments how individuals have become accustomed to habit

- Thought/ Action Preservation

This section refers to a reaction to the level of stress disrupting the link between thought and action. To prove this point, the article informs us about a military exercise and one of the participants reactions. "During an intensive military survival exercise a serviceman repeatedly gave his radio call-sign when prompted for his name. He continued to do so despite being told that his responses were incorrect. He gave his name only on the fifth prompt. Later, he said that although he knew his responses were incorrect, he was unable to break out of the response rut." (J. Leach 2018 Crisis Response- Good in a Storm IOSH Magazines viewed 11/11/19 <https://www.ioshmagazine.com/article/good-storm>)

This section of the article shows that the person caught in the incident is unable to act on the way he thoughts due to a high intensity event which has disrupted the participant.

- Action Disorders

This subtitle refers to hypoactivity and hyperactivity, hypoactivity is the decrease in decrease in both cognitive and motor functions as well as emotional demotivation and a cognitive withdrawal from the situation. The article gives examples of the unfortunate persons in the disaster freezing or being unreactive to the event unfolding around them. "In an airline evacuation a passenger sitting next to an emergency exit made no attempt to open the door, even when directed by the cabin attendant. During the Manchester Boeing 737 fire passengers were reported as sitting immobile in their seats until overtaken by smoke and toxic fumes." (J. Leach 2018 Crisis Response- Good in a Storm IOSH Magazines viewed 11/11/19 <https://www.ioshmagazine.com/article/good-storm>) The previous quote tells me that the article has found a statement that further enforces their argument that people in a crisis may show hypoactive tendencies. The article continues to talk about cognitive function and cognitive architecture. The article comments heavily on the affects a crisis will have on cognitive function during a crisis. And how emergencies can "deplete the working memory capacity, leading to task-irrelevant processing and a selectivity about which information to process." (J. Leach 2018 Crisis Response- Good in a Storm IOSH

Magazines viewed 11/11/19 <https://www.ioshmagazine.com/article/good-storm>)
Which shows that the article writer believes there is a significant link between crisis and behaviour.

In summary the article, "Crisis Response- Good in a Storm" is an informative article that demonstrates a strong relation between an emergency and the cognitive function of someone in the proposed emergency. The article informs us of this link by quoting many responses from individuals that survived an emergency commenting on the behaviour of others caught in the same incident. I believe this article is made with the intent to inform and is backed with evidence to prove there is reason for the suggestions, ideas and points made in the article. The article appears to be made for personnel that are researching health and safety to inform of reasons for human error. Whereas explaining of the errors due to cognitive behaviour in detail this article does not seem to resolve the problems it raises when only really offering training to reduce the chance of this type of error occurring.

Human Error: Error on Trial

This article is taken from the IOSH magazine as well, it comments heavily on human error and how error is categorised. This article gives arguments reasoning for the need to categorise human error and also arguments for seeing human error as a variable that should be factored in, instead of a variable that should be dismissed in an attempt to remove it. Also, this article believes these incidents are inevitable, "In other words, even if we try to understand the chains of errors that "cause" accidents, disasters will still happen." (B. Leathley 2017 Human Error: Error on Trial IOSH Magazines viewed 13/11/19 <https://www.ioshmagazine.com/article/error-trial>) This statement implies that the writer of the article believes human error is impossible to foresee and control. The article, even though appearing to understand human error and arguing it should be factored into safety plans, does not offer any solution other than training, the article uses human error, no matter the category as the main cause of fault. This article is written with the intent to argue the different ways to view human error and also inform people who are studying human error. The article raises the question of how should human error be viewed and handled, and even though it

gives good arguments there is no clear solution to human error as this article implies it is inevitable.

Piper Alpha: Regime Change

The article Piper Alpha: Regime Change, is written about the disaster of the Piper Alpha oil platform. The article gives a brief history and has the theme of the writer writing a story whilst explaining the unfolding events. The significant error that seems to be placed in this article is a human error that happened between shift changes. "Later in the day, after a shift change, the second condensate pump malfunctioned. Operators and supervisors who did not see the form completed by the engineers who had worked on the first pump saying it was out of commission pending the valve refit, completed a permit to work and restarted it, pressurising the system." (L. Wustemann 2018 Piper Alpha: Regime Change IOSH Magazines viewed 13/11/19 <https://www.ioshmagazine.com/article/piper-alpha-regime-changer>) This shows that the significant factor in the disaster of the Piper Alpha oil platform was down to human error. This is a common factor and further helps to show how fatal human error can be and that it is inevitable.

Common threads exist in articles that comment heavily on the same points. Such as the three articles in this review. Crisis Response- Good in a storm talks heavily about loss due to human behaviour and informs of many different types of behaviours that have been observed in previous events. This implies that many of the fatalities or reactions in emergency occur due to the error of the human behaviour, human error. Which is a common thread in the article Human Error: Error on Trial. Which as implied by the title focuses on human error. Which talks about the different types of human error and how to categorize human error. Both articles reason that human error is an inevitable outcome and offer training as a way to reduce the amount of human errors. Also, both articles imply there are different reasons for the occurrence of human error but give different reasons for. Such as crisis good in a storm implying that human error stems from the unfolding of catastrophic events that happen too fast for the brain to conceive, leading to loss of proper cognitive function. Whereas human error: error on trial focuses on factors such as complacency and inappropriate training leading to human error. As the articles give these reasons it

seems feasible that they offer training as a solution to resolve human error. Even though both articles offer this solution, neither article actually implies this will completely remove human error. The article Piper Alpha: Regime Changer talks about the disaster of the piper alpha oil platform in July 1988. The article also comments on how human error lead to further fatality." The shift change between the work on the compression pump and the attempt to restart it was marked by an inadequate handover. Under the flawed permit-to-work system," (L. Wustemann 2018 Piper Alpha: Regime Change IOSH Magazines viewed 13/11/19 <https://www.ioshmagazine.com/article/piper-alpha-regime-changer>) as crisis response: good in a storm does. The common thread through the three of these IOSH magazine articles as well as the argument of human error is the purpose of each article which seems to be to inform and to argue the different categories of human error which exist. As well as this, a common solution that is mentioned is more training, which does not seem to be a full solution.

Conclusion

The three articles focus on error leading to disaster and why these errors may occur. The articles show some complimentary views when focussing on the theme of human error and why human error occurs. The articles hint on training to reduce the occurrence of human error. The articles convey the impression of a factual and informative passage of text that can be enjoyed by individuals undergoing research or by others who are intrigued by the subjects. The use of examples in article one and two show they are made with an intent to prove a reason for their arguments.

References

Crisis Response- Good in a Storm.

<https://www.ioshmagazine.com/article/good-storm>

Human Error: Error on Trial.

<https://www.ioshmagazine.com/article/error-trial>

Piper Alpha: Regime Changer.

<https://www.ioshmagazine.com/article/piper-alpha-regime-changer>

Date
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Element: 2. A Technical report

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Introduction

The purpose of this technical report is to explain white metal bearings, their use and the technique of scraping and checking clearances for white metal bearings. The following report will entail the material used in these bearings, where these bearings are found on site, different ways to check the clearances and the proper technique of scraping bearings to obtain the required clearances. /

White Metal Bearings

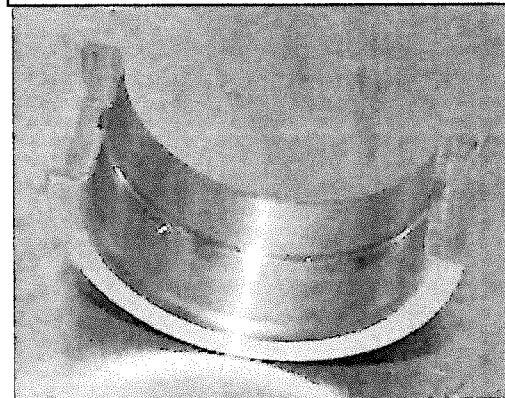
The Purpose of a Bearing

Bearings are components made with the purpose to support loads on axial and radial planes. Different bearings will have certain qualities that allow them to excel in various applications such as the use of thrust bearings to reduce the thrust force and support the axial load. Bearings are used due to their low coefficient of friction, the coefficient of friction depicts the amount of friction between mating surfaces, as white metal bearings are lubricated there is an extremely low coefficient of friction between the shaft and the bearing. It is important to have a low coefficient of friction in this area as if there is high friction there will be problems such as overheating, sparking and wear. Wear is caused by the friction of the two surfaces and the asperities that occur because of the material surface finish. The wear will lead to loss of material which in turn will affect the ability to support the load. The use of lubrication within the bearing helps to further reduce the friction between the surfaces and therefore increases the life of the bearing.

What are white metal Bearings?

White metal bearings, also known as Babbitt Metal bearings, are made up of different alloys (usually tin based) and are used as a bearing made of light metals with occasional hardened areas, this will allow wear from the contacting surfaces to create groove paths for lubrication, therefore making them easier to lubricate when in an enclosed system. The soft material acts as a sacrificial element which will prevent from wearing more important components such as the shaft and will be able to compensate for alignment issues easier than other bearings. The use of different types of alloys allows for different characteristics. Such as lead based white metal bearings which contain the properties to allow for higher loads on the bearings whereas the tin based white metals possess the properties to account for a higher surface speed than the lead based alloys. (Fig 1-

Figure 1- Half of a White Metal Bearing



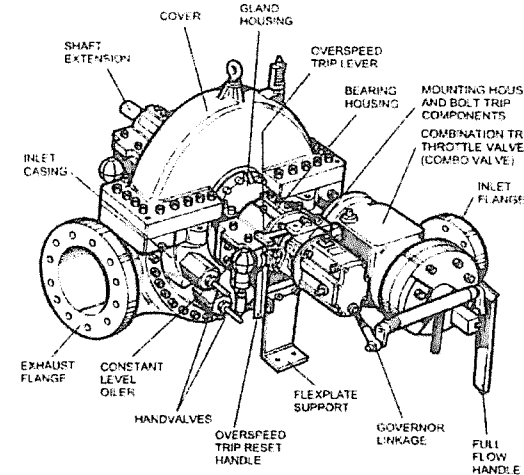
<https://www.google.co.uk/search?q=white+metal+bearings&source=lnms&tbn=isch&>

[sa=X&ved=2ahUKEwiFNa-LoPHmAhUIEawKHUcKAbIQ_AUoAnoECBEQBA&biw=1280&bih=904#imgsrc=oBWc0pGnMoe5M:&spf=1578391919821\)](#)

The need for white metal bearings has since declined from their arrival in 1839, this is due to the use of more suitable bearings such as roller or tapered bearings that provide a much less lower coefficient of friction. However within Valero, these bearings are used in steam turbines and are installed, fitted, maintained and removed by the mechanical maintenance department. The white metal bearing is enclosed within the bearing housing which is labelled in the diagram. The bearing housing is self-contained and is lubricated using denco oil bottle and sediment pot which allows the oil to run through the system. This lubrication system works on the denco bottle feeding enough oil into the housing for the oil ring to pick up and disperse throughout the housing. The readily cut groove in the bearing helps for the oil to enter the white metal bearing whereas on the ball bearings the oil comes into contact with the open cage. (Fig 2-

https://s3.amazonaws.com/mechanical-engineering/monthly_2017_03/large.58bd34e3419c2_coppusturbineparts.jpg.89ea05cdc71174fdb27eb4033533242.jpg)

Figure 2- A steam Turbine, Labelled



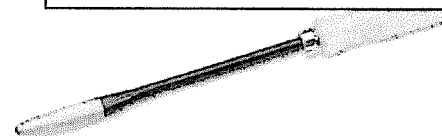
White Metal Bearing Installation/ the Scraping Technique

White metal bearings are installed and fitted by personnel with proper training and tools. The bearings are fitted properly by using the technique of scraping, this technique is used to ensure there is a proper clearance between the shaft and the bearing by removing the softer materials in a highlighted pattern. The clearance of the bearing and the shaft is checked using Plastiguage, which is a small strand of material that will compress at a certain rate. The compression when checked is compared to a set chart that will depict what clearance the used Plastiguage now represents. Figure 3 entails Plastiguage and

Figure 3- Plastiguage and the Comparison Chart



Figure 4- A Bearing Scraper



its' chart

(<http://www.burtonpower.com/media/catalog/product/cache/1/image/dbee39002c3ed3c5438224ee0989910f/K/M/KM4003.jpg>). When scraping a bearing a dye is used to show the higher spots on the bearings to highlight what needs to be scraped to remove material and create a bigger gap. The use of layout fluid or engineers blue clearly depicts the higher areas that are contacting onto the shaft. When the areas are shown the fitter will use a bearing scraper as shown in figure 3

(<http://www.mackay.co.uk/media/images/product/gedore-131-200-curved-bearing-scraper-200-mm.jpg>). The scraper is used to remove small amounts of material from the bearing without damaging it. When the bearing is to be checked the fitter can use plastiguage to determine the clearance, if this clearance isn't to the correct tolerance then the scraper can be used to increase the clearance. The technique of scraping is important to ensure that the bearing can work to the necessary standards and perform without issue, the incompleteness of scraping and improper fitting could lead to a catastrophic event. If the bearing is not fitted correctly and the clearance is not within the desired specified standard it could lead to equipment failure and damage which will have a knock on effect on the process and therefore leading to loss of profit for the company etc. as a whole for the sake of completing this technique with the proper due care and attention to detail, it could reduce the chance of losing equipment worth tens of thousands of pounds for the company and will allow the workforce to deal with bigger un-avoidable issues and jobs.

Step By Step Bearing Installation/Checking

1. Open the bearing housing on the turbine.
2. Drain the oil within the housing.
3. Remove the white metal bearing.
4. Clean the face and inspect for wear.
5. If the bearing is suitable apply Plastiguage to the shaft, refit bearings and housing lid.
6. Reopen lid and compare the Plastiguage to the chart.
7. If the clearance is in spec then clean and refit.
8. If the clearance is out of spec then apply engineer's blue/layout fluid to the shaft.

9. Re fit the bearing and the housing lid
10. Turn the shaft to allow for contact between the bearing and the shaft.
11. Remove lid and check the bearing for high spots
12. Use the scraper to remove material from the high spots.
13. Re-check with blue, high spots should be removed.
14. Clean and re-apply Plastiguage.
15. Clearances should be okay.
16. Refit and refill oil, close housing lid.

References

- http://marinediesels.info/2_stroke_engine_parts/Other_info/bearing_materials.htm
- Engineering Materials, Book by: R L Timings
- <http://www.technoslide.com/bearing-white-metal.html>
- Fig 1- https://www.google.co.uk/search?q=white+metal+bearings&source=lnms&tbn=isch&sa=X&ved=2ahUKEwiFna-LoPHmAUIEawKHUcKAbIQ_AUoAnoECBEQBA&biw=1280&bih=904#imgsrc=oBWc0pGnMoe5M:&spf=1578391919821
- Fig 2- https://s3.amazonaws.com/mechanical-engineering/monthly_2017_03/large.58bd34e3419c2_coppusturbineparts.jpg.89ea05cdc71174fdfb27eb4033533242.jpg
- Fig 3- <http://www.burtonpower.com/media/catalog/product/cache/1/image/dbee39002c3ed3c5438224ee0989910f/K/M/KM4003.jpg>
- Fig 4- <http://www.mackay.co.uk/media/images/product/gedore-131-200-curved-bearing-scraper-200-mm.jpg>

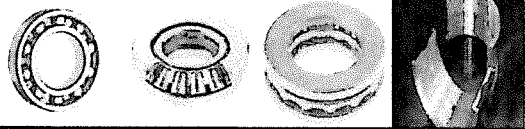
Not correctly placed.

WHITE METAL BEARINGS

By Harry Dawe

The Purpose of a Bearing

- Bearings are used to support axial and radial loads.
- Also, to reduce wear and friction
- There are different types of bearings such as:



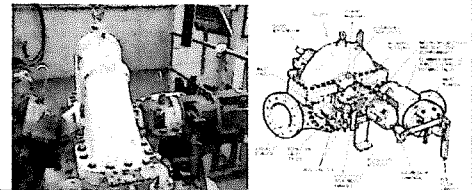
What Are White Metal Bearings?

- Alloyed metals
- Made in 1839
- Used to create different properties such as
- Higher load support
- Higher surface speed tolerance
- White metal bearings on Valero, are tin based alloys
- They have:
- High speed and load tolerances
- Grooves cut for lubrication



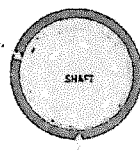
Where Can They Be Found?

- These bearings can be used in marine implications, however...
- On site, bearings are used in steam turbines
- They are found in the bearing housing of the turbine
- Bearings are fitted by the mechanical maintenance team



How Do They Work?

- Using a proper clearance and an inflow of oil the bearing keeps the shaft supported
- The softer material wears to allow the oil to flow
- The use of a clearance creates a hydrodynamic wedge

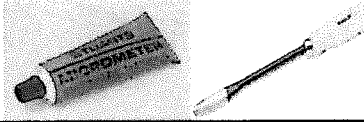


Other Alternatives and Why to Use White Metal Bearings

- Roller bearings
- Tapered bearings
- Needle bearings
- Lead based white metal
- Pros to tin based.
- Higher pressure loads
- Higher surface speed
- Easy inflow of oil

How To Install White Metal Bearings and Scraping

- Place the bottom half of the bearing
- Blue the shaft
- Place top half and the lid
- Tighten down and turn shaft
- Remove lid and check top half
- Look for high spots
- Scrape and fit again



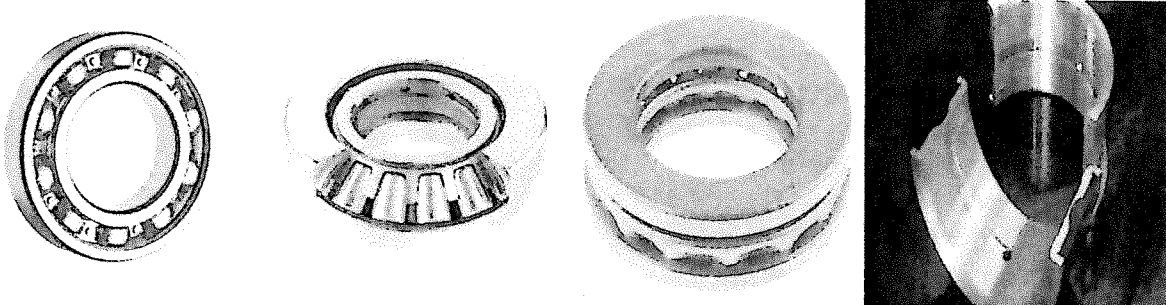
Why Is Scraping Important?

- Creates proper clearance
- Allows inflow of oil
- Stops damage
- Reduces risk of equipment failure
- Will save money as no need for replacing and repairing bearings

Any Questions?

Presentation notes

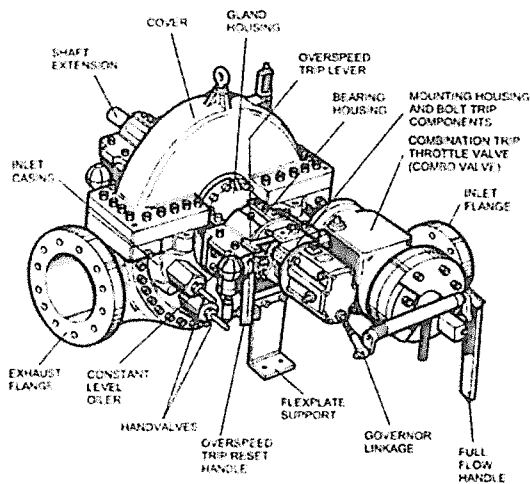
Bearings are components made with the purpose to support loads on axial and radial planes. Different bearings will have certain qualities that allow them to excel in various applications such as the use of thrust bearings to reduce the thrust force and support the axial load. There are different bearings such as roller, tapered, thrust and white metal.



White metal bearings, also known as Babbitt Metal bearings are made up different alloys (usually tin based) and are used as a bearing made of light metals with occasional hardened areas, this will allow wear from the contacting surfaces to create groove paths for lubrication, therefore making them easier to lubricate when in an enclosed system.

- They have:
- High speed and load tolerances
- Grooves cut for lubrication

within Valero, these bearings are used in steam turbines and are installed, fitted, maintained and removed by the mechanical maintenance department. The white metal bearing is enclosed within the bearing housing which is labelled in the diagram.



They work by using a hydrodynamic wedge made by the centrifugal force.

White metal bearings are installed and fitted by personnel with proper training and tools. The bearings are fitted properly by using the technique of scraping, this technique is used to ensure there is a proper clearance between the shaft and the bearing by removing the softer materials in a highlighted pattern.

When scraping a bearing a dye is used to show the higher spots on the bearings to highlight what needs to be scraped to remove material and create a bigger gap. The use of layout fluid or engineers blue clearly depicts the higher areas that are contacting onto the shaft.

The scraper is used to remove small amounts of material from the bearing without damaging it. When the bearing is to be checked the fitter can use plastiguage to determine the clearance, if this clearance isn't to the correct tolerance then the scraper can be used to increase the clearance. The technique of scraping is important to ensure that the bearing can work to the necessary standards and perform without issue

- Place the bottom half of the bearing
- Blue the shaft
- Place top half and the lid
- Tighten down and turn shaft
- Remove lid and check top half
- Look for high spots
- Scrape and fit again

Proper scraping is important because:

- Creates proper clearance
- Allows inflow of oil
- Stops damage
- Reduces risk of equipment failure
- Will save money as no need for replacing and repairing bearings

Learner Name : Matthew Thomas.

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Introduction

Three Pieces of Work shall be completed within this Assignment. Each section is divided within this Assignment and has its own Contents, Introduction, References and Bibliography Pages.

The three sections are :

Literature Review

Technical Report

Technical Presentation

For the Literature Review, the aim is to show a clear analysis of three Articles, highlighting commonalities and differences between them and indicating themes of each.

The Technical Report is a detailed write up on an Engineering Topic with the aim of enhancing knowledge on the subject in question.

Finally the Technical Presentation will display the findings of the Technical Report, and be of a Standard that those from both inside and outside the Industry are able to understand the topic.



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Module Name : Research Study and Presentation Skills.

Assignment Title : Literature Review.

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Introduction

The Literature Review to follow will cover three Articles, showing a clear analysis of each on their own but also compared to each other. The Themes of each Article will be laid out and explained and again compared to those in the other Articles. Finally an attempt will be made to join each Article into a single thread that shows the commonalities between them.

Literature Review

The three Articles that are under Review within this Document are "Crisis Response : Good in a Storm" by Dr John Leach (referred to as Article 1), "Human Error : Error on Trial" by Bridget Leathley (referred to as Article 2) and "Piper Alpha : Regime Change" by Louis Wustemann (referred to as Article 3). Each Article is from the "IOSH" Magazine Website, which is a Website written mainly by Health and Safety Professionals and aimed for Professionals working within Health and Safety Sectors.

The Tagline to an Article helps to set out the Main Aim and / or Question that the Author is trying to convey to the Reader. The Taglines to each Article help form the Main Theme and start to process of the Reader's thoughts along the path that the Author wants to communicate.

Article 1 begins with the Tagline "In emergencies many people will instinctively do things unlikely to save them. But you can rectify that." This leads effectively onto the Main Theme of Article 1 which deals with how people act during Emergency Situations. The Article states that in Emergencies, people have a tendency to perform Actions that are likely to be detrimental to themselves or Persons in the area. The Author writes a number of examples of these circumstances within the Article to back up their argument.

- "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."
- "The explosion and collapse of the Piper Alpha oil platform in 1988 resulted in the deaths of 167 men. The official inquiry found that the death toll was considerably greater than it would have been had crew members taken the initiative to escape, but apparently many made no attempt to leave the accommodation module."

is - Technical note.

There's also a number of Secondary Themes that are mentioned within this Article, one is in regards to different Behaviours commonly committed by people during Stressful situations. They are Hypoactivity (described as "a decrease in both cognitive and motor functions"), Hyperactivity (where sufferers "are prone to distraction, often flitting from task to

task”) and Cognitive paralysis (which “can lead to “freezing” behaviour (akinesia) in the face of danger.”).

- This can be written better.
Article 2’s Tagline is “Can we attribute accidents to individual failings or is error a natural part of human activity?” This again helps develop the Main Theme of Article 2 and how it is concerned with the question “Is Human Error a Part of Human Nature?” The Author quotes research by Behaviourists that attempt to split Incidents caused by Human Error into Categories that give greater understanding and explanation to the Incident that ultimately can lead to better prevention being put into place. “Human factors expert Jens Rasmussen and Reason are well known for their efforts to categorise human error. By categorising an error, it is argued, you are better able to prevent it.” *- two o.*

A secondary Theme that runs through Article 2 also explains why Human Error can affect not just the End User, but also those in Management and in Sectors such as Planning. “We are knowledgeable enough to realise that we cannot simply blame the end user, but we still try to unpick long, causal chains of errors – of end users, of senior management, of designers – seeing human error as something to be designed, managed or reinforced out of an organisation.”

Article 3 has the Tagline “July 2018 marks the 30th anniversary of the oil industry’s worst disaster, which changed safety regulation and practice.” Which explains very well the Main Theme of Article 3, which is in regards to the Piper Alpha Accident. The Article explains the details of the Accident, including what led to it, the Actions of the People on the Scene at the time and onto the Inquest held afterwards and the results of it. Article 3 is quite different to Articles 1 and 2 in that it deals less with circumstantial items and more with proven facts.

- “Occidental decided to continue production during the work rather than shut down the platform, believing its safety procedures were adequate. On 6 July the pressure valve on one of the rig’s two compression pumps that produced condensate (natural gas liquids) was removed for two-yearly recalibration and recertification and a temporary hand-tightened plate was left in its place. Later in the day, after a shift change, the second condensate pump malfunctioned. Operators and supervisors who did not see the form completed by the engineers who had worked on the first

pump saying it was out of commission pending the valve refit, completed a permit to work and restarted it, pressurising the system.”

Both Articles 2 and 3 are written by Health and Safety Professionals. Bridget Leathley was at the time of writing the Article (July 2017) a “freelance health and safety consultant” and “has been writing for health and safety publications since 1996”, whereas Louis Wustemann had at the time of writing the Article (July 2018) “written, edited and consulted on health and safety, environmental and employment matters for more than 25 years.” Article 1 however, was written by Dr John Leach, who at the time of writing the Article (August 2018) was a “senior research fellow at the University of Portsmouth’s Extreme Environmental Medicine and Science Group”.

The differing background of these three individuals has meant that each Article is targeted to different audiences and also gets the message across in different ways. Whilst all Three Articles are mainly directed to Health and Safety Professionals in the first instances, the Themes of each are also targeted to different groups.

Write down.
On top of being aimed at Health and Safety Professionals, Article 2 is also of interest to Management Teams. The Understanding of how different forms of Human Error at all levels of work can possibly lead to Incidents and help in the creation of Systems that can help to prevent Accidents happening in the Future. This Article attempts to explain how Human Error is a consistent present in all walks of life and at every level. The Article contains a lot of descriptive Information; however it has a feel of trying to cover too many items within one umbrella. The Article as mentioned, tries to cover Human Error, its definition and categorisation and how Error can also be Variability.

Like Article 2, Article 3 is aimed at Health and Safety Professionals and Management Teams as it relates the details into a terrible accident and the failures that led to it. Taking learnings from this will result in a better, safer working environment thanks to the Development of more robust Health and Safety Systems within the Workplace. This Article deals very much in Facts and is very informative.

Article 1 is certainly aimed mainly towards Health and Safety Professionals, but the learnings from it can be understood and considered by People in all walks of life.

Understanding that Stress can cause People to act in Unconventional Ways is certainly something that can be reviewed and Items, such as Training and Systems, can be put into place to attempt to reduce the likelihood of these detrimental actions happening. The Article is put across in a way to use Shock as a method of enhancing the Main Theme. By quoting the different poor choices made during difficult situations, it heightens the Reader's desire to understand the problem. This could be interpreted as being Entertaining, but by then explaining the different Behavioural and Cognitive Actions associated with Stress, it becomes a very informative Article.

Returning to the Tagline of each Article, the Themes and messages within Articles 1 and 3 answer the Question / Aim posed by the Article Tagline. Article 1 explains how People can indeed perform actions that are a danger to themselves in Stressful Situations. It also gives a limited response to how Training is the Answer to countering this. Article 3 explains the details surrounding the Piper Alpha accident and lays bare the Fallout from it. It defines the facts without making judgement. Article 2, however, changes to explain that far from Human Error being an attribute to accidents, Human Error is simply Human Variability which can be as helpful a characteristic and it can be harmful. This leaves the Article without a clear answer to its initial claim.

All Articles touch on how Human Error can result in dire consequences to either the Individual or those in the area. Each however shows this in a different light. Article 1 focuses on how Stressful Situations can lead to Individuals being unable to concentrate and formulate the correct response to a situation and thus place themselves in danger. Article 2 however places more focus on how Human Error is a normal part of everyday life and Systems need to be put into place to account for these variabilities. Article 3 also touches on the need for Systems to be in place, but the spotlight here is on the Systems being in place to prevent Accidents and also how to deal with them should they occur.

This being said, the Main Themes from each of the three Articles can be collated together into a single running thread and message. This message states that :

- "People act poorly in Stressful Situations. People, through decision or in-decision, can act in a way that is detrimental to their own and / or other's wellbeing. However, there is a possibility that this in-decision can be disciplined out of People through

correct Training and the appropriate use of Systems and Documentation. This is generally a method best exercised at the top level of any company or business and rolled out from there. These Actions will help to reduce Stressful Situations on workers and persons within the company and thereby prevent accidents, some of which can affect more than just the Person or Peoples in the immediate area."

✓ This should be a
Conclusion.

References and Bibliography

Websites

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"IOSH Magazine", "Human Error L Error on Trial", Bridget Leathley, Visited October 2019, <www.ioshmagazine.com/article/error-trial >

"IOSH Magazine", "Piper Alpha : Regime Changer", Louis Wustemann, Visited October 2019, < www.ioshmagazine.com/article/piper-alpha-regime-changer >

Learner Name : Matthew Thomas.

Course : HNC Process Operations Engineering, Year 1.

Module Code : PCPO4002.

Module Name : Research Study and Presentation Skills.

Assignment Title : Technical Report.

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Introduction

The Technical Report to follow will cover the Subject of “Rubber Materials used within Valve and Pump Arrangements” focusing on Dairy Processing. The Industry Standard within Dairy Processing is Silicone Rubber, however after a number of Failures, focus was placed on whether this was the correct option. This Report covers the details of this focus and asks the question, “Does Industry Standard mean Best for Industry?”

Technical Report

For Valve and Pump Arrangements in Dairy Processing, the Industry Standard is Silicone Rubber, but over the years, there have been numerous Rubber Failures that have resulted in the loss of Product and Chemicals and even resulted in injury due to causing Slip Hazards.

After these Incidents, the question began to be asked "WHY?"

Q) "Why do we keep having Rubber Failures?"

A) "Not completely sure, but we think the Silicone isn't up to the job."

Q) "Why do we use Silicone?"

A) "It's the Industry Standard, everyone uses it."

Q) "Why can't we change Rubber?"

A) "It's what the Supplier recommends that we use."

Q) "Why do we have to do what the Supplier recommends?"

This became the Lightbulb moment that began a process of looking into whether the Industry Standard is actually the Right Option and asks the question, "Does Industry Standard mean Best for Industry?"

When people think about Rubber, generally the thought is that all Rubber is the same. However, this isn't true. There are many different types of Rubber and each have their own Strengths and Weaknesses. However, within Dairy Processing, the Rubber must be Food Safe. This limits what Material can be used to only Four Options.

- Silicone
- EPDM
- FKM (Viton)
- NBR (Nitrile)

Each Material is very different, offering their own Strengths and Weaknesses (as shown by testing completed by Mykin Inc.,(Website Viewed November 2019, <https://mykin.com/>)), but how do these hold up against what Characteristics are desirable within Dairy Processing.

Silicone : Silicone Rubber has the joint best Operating Temperature Range out of the four options, being suitable for use from -54°C up to 232°C. It also has strong Chemical Resistance to a wide range of items, including citric acid, glucose, water and whey. But it doesn't have a very good range of Physical Resistances, being only good against compression.

EPDM : EPDM Rubber has the smallest Operating Temperature Range of the four options, being suitable for use only from -48°C to 121°C. But it has the best Physical Resistance range and a good range of Chemical Resistances. Included within these are Resistances against caustic, citric acid, glucose, water, whey, abrasion, compression, dynamic movements, tearing and water swell.

FKM : FKM Rubber has a good Operating Temperature Range of -26°C to 204°C and has very good Chemical Resistances to alkanes, animal fats, citric acid, glucose and nitric acid. However the range of strong Physical Resistances is limited to only compression and dynamic movements.

NBR : NBR Rubber has the joint best Operating Temperature Range out of the four options, being suitable for use from -54°C up to 232°C. It also has a good range of strong Chemical Resistances, but its range of strong Physical Resistances is limited. Among its Resistances are alkanes, animal fats, citric acid, glucose, water, whey, compression and dynamic movements.

According to the "Tetra Pak Processing Systems (1995), Dairy Processing Handbook", the main characteristics required in Dairy Processing are :

- Resistance to animal fats, caustic soda, nitric acid and whey.
- Good tensile strength and dynamic properties.
- Good abrasion, tear and water swell resistance.

When these items are inspected in more focus and each Material compared (again using the testing data from Mykin Inc.,(Website Viewed November 2019, <https://mykin.com/>)) , a picture starts to build up on which Rubber is best.

chemical resistance	NBR	EPDM	Silicone	FKM
animal fats	very good	good	very poor	very good
caustic soda	average	very good	good	average
nitric acid (0 - 50%)	poor	good	very poor	very good
whey	very good	very good	very good	poor

Looking at just Chemical, only EPDM scores Good or Very Good on the four main Resistance requirements.

physical resistance	NBR	EPDM	Silicone	FKM
tensile strength	very good	very good	very poor	very good
maximum elongation (%)	600	600	800	300
min hardness	40	40	25	50
max hardness	90	90	80	95
abrasion resistance	good	very good	very poor	good
compression set	very good	very good	very good	very good
dynamic properties	very good	very good	very poor	very good
tear resistance	good	very good	very poor	average
water swell resistance	good	very good	good	good

When looking at just Physical, again only EPDM scores Very Good on every desirable Resistance.

This shows that EPDM has the desired Resistances, both chemically and physically, that are required within Dairy Processing. So why isn't EPDM the Industry Standard? When Price is looked at, it's likely that the reason is found.

	NBR	EPDM	Silicone	FKM
average cost per linear metre	£57.50	£69.12	£48.49	£330.20



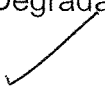
When looking at the average cost per linear metre, Silicone comes out as the cheapest. Combine this with its Good Resistance to Water Swell, Caustic and Whey and a Good Range on Hardness Scale, all of which are very high desirables within Dairy Processing, it is easy to understand why it became Industry Standard.

However the question remains "Does Industry Standard mean Best for Industry?" Taking Price out of the equation, and just looking at the Resistances, Silicone does not come out on top. EPDM is the only Rubber that performs Good to Very Good in each desirable item in Dairy Processing. Do these better Resistances offset a Price Increase of roughly 42.54%? The only way to truly find out is to Test. This Test was initiated in October 2014.

154 Valves had their Rubber Seals replaced with EPDM Seals and a new Maintenance Regime implemented to inspect these Seals and document their condition. Over the next Three Years, these Seals were inspected and their condition was recorded.

After Eleven Months, each Seal was replaced, but upon Inspection, they were found to be in a Good Condition. The new Seals were left in longer to further test.

Over the next Two Years, the Seals were inspected and each time found to be in a Good Condition with no Damage or Wear on them. The test continued until the Two Year Target was reached and the Seals were replaced. However upon replacement, the Seals still showed no signs of Degradation.



Date of Inspection	Valve ID	Type of Material	Condition on Inspection	Replaced
Oct-14	V5004	Silicone	Seal badly worn	Yes
Sep-15	V5004	EPDM	Seals in good condition	Yes
Jul-16	V5004	EPDM	Seals Inspected on PPM. No Damage Found	No
Aug-17	V5004	EPDM	OK	Yes
Oct-14	V5023	Silicone	Seals badly worn	Yes
Sep-15	V5023	EPDM	Seals in good condition	Yes
Jun-16	V5023	EPDM	Seals Inspected on PPM. No Damage Found	No
Aug-17	V5023	EPDM	OK	Yes
Oct-14	V5051	Silicone	4 small slithers missing around plate edge (each corner) : Spoke to Supplier, this is as Designed	Yes
Sep-15	V5051	EPDM	Seals in good condition	Yes
Aug-16	V5051	EPDM	Seals Inspected on PPM. No Damage Found	No
Mar-17	V5051	EPDM	Seals Inspected on PPM. No Damage Found	No

This Testing proved a minimum Two Year Lifespan of EPDM Seals in Applications where Silicone had been much lower. So is the Industry Standard the best option for the Industry?



Conclusion

After inspecting the different Chemical and Physical Resistances of the Four Food Safe Options available, there becomes a clear Answer to the Question "Does Industry Standard mean Best for Industry?" Only EPDM scores highly on each Section.

When looking at the Testing completed after the switch to EPDM, the fact that EPDM Rubber lasts a minimum of Two Years in each Application which is much more than the Silicone Rubber, more than justifies the price increase of 42.54%.

This research would indicate that it's not. But instead, EPDM is the better solution and should take pride of place as the new Industry Standard.



Summary

Implementing EDPM seals instead of Silicone seals has decreased Rubber Failure and increased Rubber lifespan within Dairy Processing to over 2 years.

Resulting in better quality Production Runs and bringing Success to the Dairy Team.

Word Count : 1100 (tables are not counted in Word Count)

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<<https://www.tetrapak.com/uk/about/cases-articles/cheese-technology-guide>>
Mykin Inc., Rubber Chemical Resistance Chart, Viewed November 2019,
<<https://mykin.com/>>

Learner Name : Matthew Thomas.

Course : HNC Process Operations Engineering, Year 1.

Module Code : PCPO4002.

Module Name : Research Study and Presentation Skills.

Assignment Title : Technical Presentation.

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Introduction

This Section of the Assignment will cover the Presentation of the Findings of the Technical Report. Also included will be a Single Sheet Handout for distribution with the Presentation.

Technical Report Presentation

Please find a copy of the Technical Report Presentation over the next few Pages.

Learner Name : Matthew Thomas.

Course : HNC Process Operations Engineering, Year 1.

Module Code : PCPO4002.

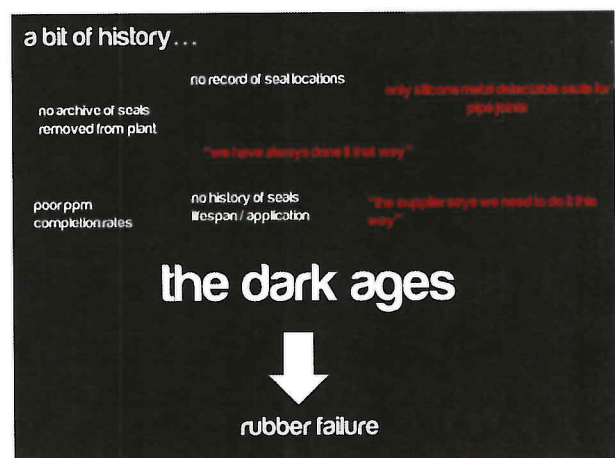
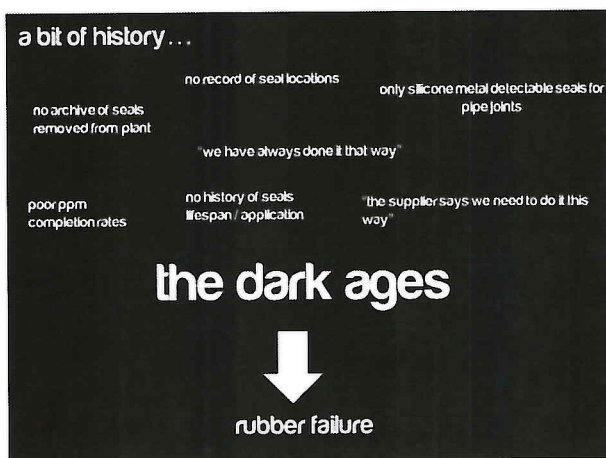
Module Name : Research Study and presentation Skills.

Assignment : Technical Report

on

Rubber Materials used within Valve and Pump Arrangements

does industry
standard mean
best for
industry?



...do we keep having rubber failures?

...can't we change rubber material?

...do we use silicone rubber?

why...

...do we have to do what the supplier recommends?

Rubber Types

rubber name	designation	chemical name
afias	fepm	tetrafluoroethylene-propylene
buna	nbr	acrylonitrile-butadiene
butyl	ir	isobutylene-isoprene
chemraz	flkm	perfluoroelastomer
ethylene propylene	epdm	ethylene propylene diene monomer
fluoroelicone	fvmq	fluoroelicone
hydrogenated nitrile	hnbr	hydrogenated acrylonitrile-butadiene
isoprene	ir	synthetic cis-polyisoprene
kalrez	flkm	perfluoroelastomer
natural rubber	nr	cis-polyisoprene
neoprene	cr	chloroprene
nitrile	nbr	acrylonitrile-butadiene
polyurethane	au	polyester-urethane
silicone	vmq	silicone
silvitz	flkm	perfluoroelastomer
styrene butadiene	abr	styrene butadiene
viton	flkm	fluorocarbon

food industry = food safe equipment and spares

silicone

epdm

limited choices
of materials

flkm (viton)

nbr (nitrile)

food industry = food safe equipment and spares

silicone

epdm

operating range	-54°C	232°C
good chemical resistance to		
air	cold ammonia gas	citric acid
glucose	sodium chloride	sodium hydroxide
water	whey	
good physical resistance to		
compression		

flkm (viton)

nbr (nitrile)

food industry = food safe equipment and spares

silicone

epdm

operating range	-48°C	121°C
good chemical resistance to		
air	cold ammonia gas	caustic soda
citric acid	glucose	silicone oils
sodium chloride	sodium hydroxide	sodium hypochlorite
sodium peroxide	steam below 200°C	water
whey		
good physical resistance to		
abrasion	compression	dynamic movements
tearing	water swell	

flkm (viton)

nbr (nitrile)

food industry = food safe equipment and spares

silicone

epdm

operating range	-26°C	204°C
good chemical resistance to		
air	alkenes	animal fats
chlorine water	citric acid	fatty acids
glucose	lubricating oils	motor oils
nitric acid (0 - 50%)	silicone oils	sodium hypochlorite
sodium peroxide		
good physical resistance to		
compression	dynamic movements	

flkm (viton)

nbr (nitrile)

food industry = food safe equipment and spares

silicone

epdm

operating range	-54°C	232°C
good chemical resistance to		
alkenes	cold ammonia gas	animal fats
citric acid	glucose	lubricating oils
motor oils	silicone oils	sodium chloride
water	whey	
good physical resistance to		
compression	dynamic movements	

flkm (viton)

nbr (nitrile)

food industry = food safe equipment and spares

silicone

operating range	-54°C	232°C
good chemical resistance to	alkalis	alkaline acids
air	good	good
glucose	good	good
water	very good	very good
concentrated	good	good

operating range	-54°C	232°C
good chemical resistance to	alkalis	alkaline acids
air	good	good
glucose	good	good
water	very good	very good
concentrated	good	good

fkm (viton)

epdm

operating range	-40°C	121°C
good chemical resistance to	alkalis	alkaline acids
air	good	good
glucose	good	good
water	very good	very good
concentrated	good	good

operating range	-54°C	232°C
good chemical resistance to	alkalis	alkaline acids
air	good	good
glucose	good	good
water	very good	very good
concentrated	good	good

nbr (nitrile)

resistant	nitrile	epdm	silicone	viton
air	good	very good	very good	very good
alkanes	very good	poor	good	very good
cold ammonia gas	very good	very good	very good	poor
hot ammonia gas	poor	good	very poor	poor
animal fats	very good	good	very poor	very good
caustic soda	average	very good	good	average
chlorine water	average	good	very poor	very good
chloric acid	very good	very good	very good	very good
fatty acids	good	average	average	very good
glucose	very good	very good	very good	very good
lubricating oils	very good	poor	poor	very good
motor oils	very good	poor	good	very good
nitric acid (10-50%)	poor	good	very poor	very good
silicone oils	very good	very good	average	very good
sodium chloride	very good	very good	very good	very good
sodium hydroxide	good	very good	very good	good
sodium hypochlorite	good	very good	good	very good
sodium peroxide	good	very good	poor	very good
steam below 200°C	poor	very good	average	poor
water	very good	very good	very good	good
whisky	very good	very good	very good	poor

resistant	nitrile	epdm	silicone	viton
air	good	very good	very good	very good
alkanes	very good	poor	good	very good
cold ammonia gas	very good	very good	very good	poor
hot ammonia gas	poor	good	very poor	poor
animal fats	very good	good	very poor	very good
caustic soda	average	very good	good	average
chlorine water	average	good	very poor	very good
chloric acid	very good	very good	very good	very good
fatty acids	good	average	average	very good
glucose	very good	very good	very good	very good
lubricating oils	very good	poor	poor	very good
motor oils	very good	poor	good	very good
nitric acid (10-50%)	poor	good	very poor	very good
silicone oils	very good	very good	average	very good
sodium chloride	very good	very good	very good	very good
sodium hydroxide	good	very good	very good	good
sodium hypochlorite	good	very good	good	very good
sodium peroxide	good	very good	poor	very good
steam below 200°C	poor	very good	average	poor
water	very good	very good	very good	good
whisky	very good	very good	very good	poor

in the lines during cheese production there is lots of fat and whey but during cleaning there is a lot of caustic soda and nitric acid

resistant	nitrile	epdm	silicone	viton
animal fats	very good	good	very poor	very good
caustic soda	average	very good	good	average
nitric acid (10-50%)	poor	good	very poor	very good
whisky	very good	very good	very good	poor

nitrile : good in production, average at best in cleaning

epdm : good to very good in production and cleaning

silicone : good for caustic and whey, but not for fat or acid

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	nitrile	epdm	silicone	viton
tensile strength	very good	very good	very poor	very good
maximum elongation (%)	600	600	800	300
min hardness	40	40	25	50
max hardness	90	90	80	95
abrasion resistance	good	very good	very poor	good
compression set	very good	very good	very good	very good
dynamic properties	very good	very good	very poor	very good
tear resistance	good	very good	very poor	average
water swell resistance	good	very good	good	good

	nitrile	epdm	silicone	viton
tensile strength	very good	very good	very poor	very good
maximum elongation (%)	600	600	600	300
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tear resistance	good	very good	very poor	average
water swell resistance	good	very good	good	good

with valves and pumps, there is almost constant movement of liquids.
resistance to damage caused by these actions and swelling from the liquids is paramount

	nitrile	epdm	silicone	viton
tensile strength	very good	very good	very poor	very good
maximum elongation (%)	600	600	600	300
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abrasion resistance	good	very good	very poor	good
compression set	very good	very good	very good	very good
dynamic properties	very good	very good	very poor	very good
tear resistance	good	very good	very poor	average
water swell resistance	good	very good	good	good

nitrile : good all round material

epdm : very good all round material

silicone : good compression and dynamic movement resistance, but poor abrasion and tear

viton : good all round material, but susceptible to tearing

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viton : good all round material, but susceptible to tearing

and as with everything, price will play a part

	nitrile	epdm	silicone	viton
average cost per linear metre	£57.50	£69.12	£48.49	£330.20

and as with everything, price will play a part

	nitrile	epdm	silicone	viton
average cost per linear metre	£57.50	£69.12	£48.49	£330.20

epdm the way to go...

resistant	nitrile	epdm	silicone	viton
aromatic oils	very good	good	very poor	very good
caustic soda	average	very good	good	average
nitric acid (60%)	poor	good	very poor	very good
whisky	very good	very good	very good	poor
tensile strength	very good	very good	very poor	very good
maximum elongation (%)	600	600	600	300
min hardness	40	40	25	50
max hardness	90	90	80	95
abrasion resistance	good	very good	very poor	good
compression set	very good	very good	very good	very good
dynamic properties	very good	very good	very poor	very good
tear resistance	good	very good	very poor	average
water swell resistance	good	very good	good	good
average cost per linear metre	£57.50	£69.12	£48.49	£330.20

testing

begin collection of seal information with known data-point

£15k spent on new seats

£10k spent on labour

changed 154 valve seals in 2x 48hour shutdowns

pipe joints labelled and joint type recorded at a cost of £15k in labour

£40k investment to prove research was correct



right seal in right application

Date of inspection	Value ID	Value Type	Value Size	Value Area	Process Material	Magnetic? Non-Magnetic	Colour of Faces	Number of Faces	Condition on inspection	Fault Level	Repaired/Quarantined/Bagged	Comments	Seen Damage	Damage Figure
Oct-14	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5004	V5004 Damage	
Jan-15	V5024	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5024	
Aug-17	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5004	V5004	
Oct-14	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5023	V5023 Damage	
Sep-15	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal in good condition	1	No	V5023		
Jun-16	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5023	
Aug-17	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5023	V5023	
Oct-14	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	5	4 x 1mm x 1mm missing around perimeter of each corner	3	Yes	V5051	V5051 Damage	
Sep-15	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5051	V5051	
Aug-16	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	
Mar-17	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	

right seal in right application

Date of inspection	Value ID	Value Type	Value Size	Value Area	Process Material	Magnetic? Non-Magnetic	Colour of Faces	Number of Faces	Condition on inspection	Fault Level	Repaired/Quarantined/Bagged	Comments	Seen Damage	Damage Figure
Sep-15	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5004	V5004 Damage	
Sep-15	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5004	V5004	
Aug-17	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5004	V5004	
Sep-15	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal in good condition	1	Yes	V5023	V5023 Damage	
Sep-15	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5023	V5023	
Jun-16	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5023	
Aug-17	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5023	V5023	
Oct-14	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	5	4 x 1mm x 1mm missing around perimeter of each corner	3	Yes	V5051	V5051 Damage	
Sep-15	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5051	V5051	
Aug-16	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	
Mar-17	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	

right seal in right application

Date of inspection	Value ID	Value Type	Value Size	Value Area	Process Material	Magnetic? Non-Magnetic	Colour of Faces	Number of Faces	Condition on inspection	Fault Level	Repaired/Quarantined/Bagged	Comments	Seen Damage	Damage Figure
Oct-14	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5004	V5004 Damage	
Sep-15	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5004	V5004	
Aug-17	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5004	V5004	
Oct-14	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5023	V5023 Damage	
Jun-16	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal in good condition	1	Yes	V5023	V5023	
Jun-16	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	No	Seal inspected on PPM No Damage Found	V5023	
Aug-17	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5023	V5023	
Oct-14	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	5	4 x 1mm x 1mm missing around perimeter of each corner	3	Yes	V5051	V5051 Damage	
Sep-15	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5051	V5051	
Aug-16	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	
Mar-17	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	

right seal in right application

Date of inspection	Value ID	Value Type	Value Size	Value Area	Process Material	Magnetic? Non-Magnetic	Colour of Faces	Number of Faces	Condition on inspection	Fault Level	Repaired/Quarantined/Bagged	Comments	Seen Damage	Damage Figure
Oct-14	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5004	V5004 Damage	
Oct-14	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal in good condition	1	Yes	V5004	V5004	
Aug-17	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5004	V5004	
Aug-17	V5004	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5004	V5004	
Oct-14	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	Seal badly worn	4	Yes	V5023	V5023 Damage	
Sep-15	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5023	V5023	
Aug-17	V5023	Plug	4.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	Yes	V5023	V5023	
Oct-14	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	5	4 x 1mm x 1mm missing around perimeter of each corner	3	Yes	V5051	V5051 Damage	
Sep-15	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	7	Seal in good condition	1	Yes	V5051	V5051	
Aug-16	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	
Mar-17	V5051	Plug	3.0	V504	EPDM	Non-Magnetic	Black	12	OK	1	No	Seal inspected on PPM No Damage Found	V5051	

epdm is best



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Websites

Tetra Pak, Dairy Processing Handbook. Viewed November 2019. <<https://dairyprocessinghandbook.tetrapak.com/>>
Tetra Pak, Cheese Technology Guide. Viewed November 2019. <<https://www.tetrapak.com/uk/about/cases-articles/cheese-technology-guide>>
Mykin Inc. Rubber Chemical Resistance Chart. Viewed November 2019. <<https://mykin.com/>>

Technical Report Handout

Please find a copy of the Technical Report Handout over the Page.

Rubber Materials used within Valve and Pump Arrangements

For Valve and Pump Arrangements in Dairy Processing, the Industry Standard is Silicone Rubber, but over the years, there have been numerous Rubber Failures that have resulted in the loss of Product and Chemicals and even resulted in injury due to causing Slip Hazards.

So why use it?

Ultimately it comes down to a few items :

- Low Price
- Food Safe Material
- Good Resistance to Water Swell
- Good Range on Hardness Scale
- Good Resistance to Caustic
- Good Resistance to Whey

All of these facts mean that Silicone is a multipurpose Rubber that can be used across the Dairy Processing Site.

But is it right?

There are very limited choices that can be used with Dairy Processing, as the Rubber must be Food Safe. Each has their good points.



epdm the way to go

Properties	silicone	epdm	flkm (viton)	nbr (nitrile)
Temperature range	-50 to 200°C	-20 to 120°C	-20 to 200°C	-20 to 100°C
Chemical resistance	Good	Good	Good	Good
Mechanical properties	Good	Good	Good	Good
Average cost per litre	£37.00	£30.00	£40.00	£20.00

The main characteristics required in Dairy Processing are

- Resistance to animal fats, caustic soda, nitric acid and whey.
- Good tensile strength and dynamic properties.
- Good abrasion, tear and water swell resistance.

For these Characteristics, only one Option consistently comes out on top.

EPDM frequency scores high on every occasion, especially when compared to

the Industry Standard.

So is the Industry Standard the best option for the Industry?

This research would indicate that it's not.

But instead, EPDM is the better solution and should take pride of place as the new Industry Standard.

epdm is best



Implementing EPDM seals instead of Silicone seals has decreased Rubber Failure and increased Rubber lifespan within Dairy Processing to over 2 years.

Resulting in better quality Production Runs and bringing Success to the Dairy Team.

Books : Tetra Pak Processing Systems (1995), Dairy Processing Handbook : Invenys APIV, Dairy Technology

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