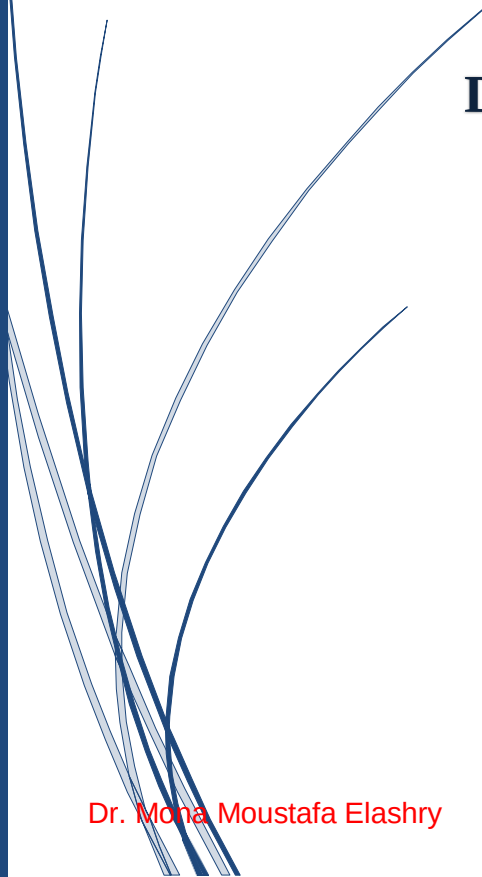




Final Project 2

PMG 497



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MIDOCEAN UNIVERSITY

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Lubricants Application and Concerns Toward Health and Environment

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Final Project - 2
Faculty of Management - Midocean University

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Acknowledgment

With all the love and respect to my parents, my wife and colleagues who were there for me and supported me in this long journey and special thanks to Dr. Mona Elashery for the great support you have provided along the way.

Thank you very much

Dedication

This research is dedicated to all those involved and must tolerate the dangers of lubrications to put food on the table and who are not aware of the hazards associated, the importance of companies is important, but lives are more important

Abstract

This study aims to reveal the effect of Lubricants Application and Concerns Toward Health and Environment .To achieve the objectives of the study, the researcher used the descriptive analytical approach, where the study community was used with a number of variables and the study was applied to the study sample consisting of a number of 20 of employees and (the oil & gas industry in Saudi Arabia . between (Lubricants made of base oil and Biodegradable lubricant) This study contributes to the literature by investigating the relationship Practical applications: The study provides recommendations to the relevant parties in one of the oil refineries in the western region of Saudi Arabia on the importance of applying (Lubricants made of base oil) and its relationship to (Biodegradable lubricant which raises the level of the organization.

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1. Chapter 1: Introduction

A chariot was once a machine used by the ancient Egyptians, early chariots were found at the tombs of Yuaa and Thuiu back in 1400 B.C. Soon the wooden wheels hubs were becoming charred from frictional heat. That was the spark of many trials and experiments to reduce the cool down the generated heat as a result of friction using water and some olive oil. Eventually, they have noticed that some more viscous liquid didn't only prevent cool down the generated heat but even prevented the heat from being generated. furthermore, the wheels were moving more freely and smoother than before. (The History of Lubrication, [Jim Fitch](#), Noria Corporation)

Since then, lubricants have become very essential, they have developed enormously with time. Many forms like oil, grease, fluids. furthermore, characteristics are wide spreading, there are different viscosity grades, temperature endurance, pressure handling and so on. In addition, lubricants are becoming more critical and crucial with the big evolution of industries and factories, food and beverages machinery, oil & gas, textiles. Almost every machine used even at homes will require some type of lubricant to keep running efficiently without failures.

Petroleum-based lubricants are most popular form known in the modern form. It is derived from crude oil and being processed to be widely used in industries .([Bennett Fitch](#), Noria Corporation) Synthetic lubricants are another modern form is widely used and it is artificially fmade by chemical compounds rather the being derived from refined crude oil. ([Jonathan Trout](#), [Jim Fitch](#), Noria Corporation). Moreover, another form of lubricants is the bio-based lubricants made of renewable energies like vegetable oil and animal fats .([Bennett Fitch](#), Noria Corporation)

1.1 2.1 Research Problem

1.2

The current research aims to draw your attention to the negative impact of every form of lubricants mentioned, mainly health related issues and environmental pollution. lubricants are being used widely as mentioned in the introduction, and after certain time, those lubricants are being disposed which means there are concerns regarding direct human beings contacts and the affect on both health and environment.

Lubricants might seem to be human friendly and the effect of their vapor inhalation and hand contact might seem mild as they don't cause immediate serious illness ,unlike hydrocarbons such benzene substance that is highly carcinogenic if inhaled or in direct contact through splashes or handling without applicable personal protective equipment .Although , the affect of being exposed to lubricants is not immediate ,long term exposure could cause serious illness due to the nature of lubricants derived from crude oil . In addition, synthetic oil chemical formulation could also lead to serious illness due some chemical additives. Many aspect and characteristics to be taken in considerations like, volatility, temperature, contaminations.

1.3 2.1 Research Significance

The significance of this research strengthens the need of balanced, reasonable and strict solutions for saving human lives and raise the

responsibility senses and the awareness level of keeping our environment clean unharmed as well as keeping industries running efficiently without disturbing by figuring out better solutions, better ways of lubricants handling, usage and disposing.

being exposed to lubricants is not immediate, long term exposure could cause serious illness due to the nature of lubricants derived from crude oil. In addition, synthetic oil chemical formulation could also lead to serious illness due some chemical additives. Many aspect and characteristics to be taken in considerations like, volatility, temperature, contaminations.

1.4 Research Questions

This research study will be about offering reasonable solutions or alternatives for lubricants handling, disposing and to study the impact of lubricants toward individual's health and the environment

2.1 Main research question & sub-Questions

- Main Research Question: What possible methods, techniques and procedures can be used to control lubricants environmental pollution and prevent health problems?
 - **Sub-Question 1:** what are the possible remedies to control lubricants spill and wasted lubricant disposal?
 - **Sub Question 2:** Are there additional safety measures to be taken in consideration while handling lubricants?

- **Sub-Question 3:** Can we count on bio-based lubricants that are highly biodegradable and more environment friendly to replace crude based lubricants?

2.1.1 Research Objectives

The main aim of this study is to determine the focus points and to analyze, evaluate and examine the key objectives of this study is based on

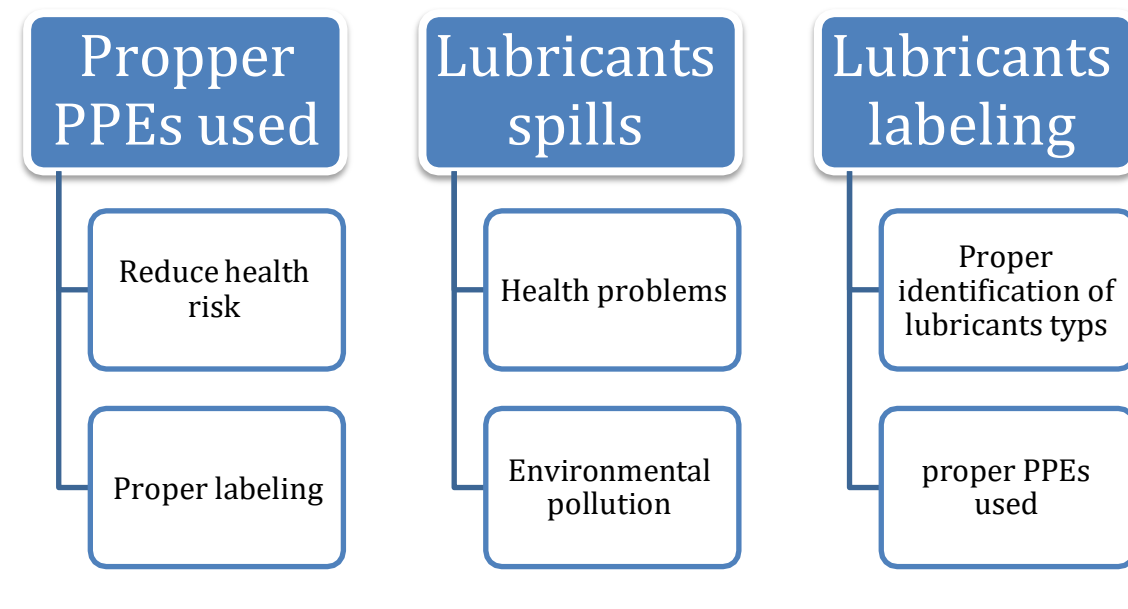
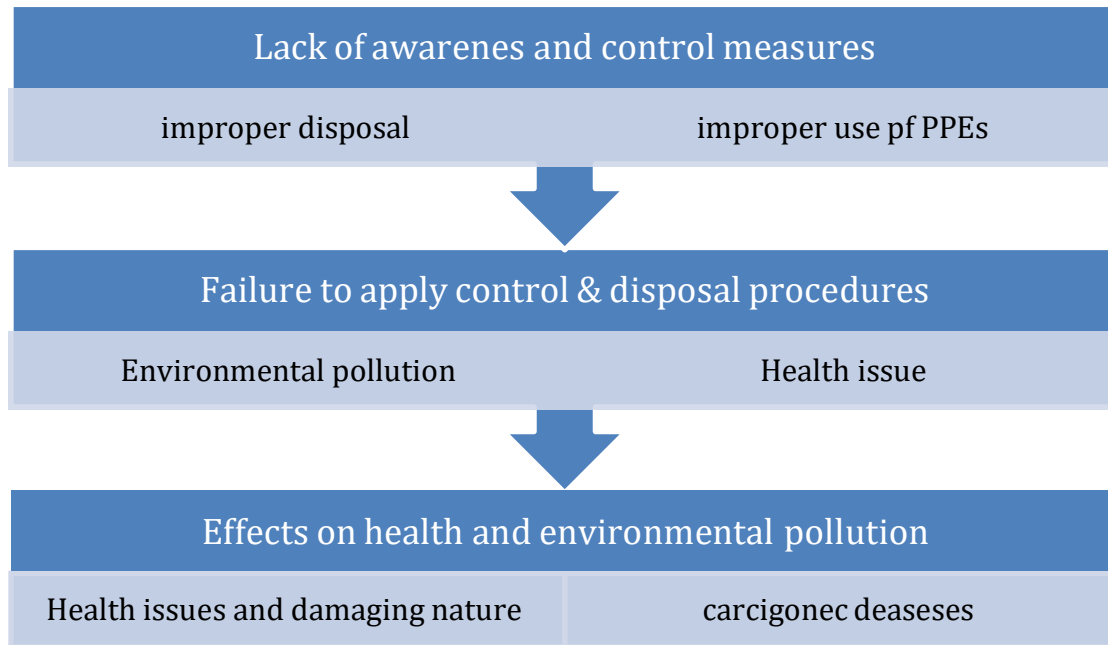
- ✓ To identify all possible lubrication spills and best practices of used lubricants disposal.
- ✓ To evaluate the effectiveness of current safety measures, personal protective equipment and labeling used while handling lubricants.
- ✓ To examine the effectiveness and of replacing crude based lubricants with bio-degradable lubricants and the impact on the environment.

1.5 2.1 Research Hypotheses

- There is a statistical positive relationship between lubricants spill, waste disposal and environmental pollution
- There is a positive relationship between using proper PPEs and reducing health risks
- There is a significant statistical positive relationship between lubricants labeling and proper lubrication identification and proper storage
- There is a significant relationship between replacing crude based lubricants with bio-degradable and the impact on environment

1.6 2.1 Research Model

Presents the relation between independent variables and the effect on independent variable



6 Chapter 2: Literature Review

At this section it is important to review the main subject of this research, which is Lubricants importance and concerns toward human lives and environment, lubricant is essential for industries and many machineries. However, safety of people especially those in close contact with lubricant is a major concern. In addition, a safe environment is also a major concern, consuming lubricant never mean to damage environment around which could also lead to human health issues.

6.1

2.1 Lubricants made of base oil (The independent variable#1) & Bio degradable lubricant (The independent variable#2):

As most of us know that lubricant at the old ages were made of animal fat, and through time people become using lubricants made of base oil. waste lubricant made of base oil can only be recycled or used somehow but eventually, where this wasted lubricant will end up a big question mark as they are not degradable it can be used in wide variety of shapes and it is involved in many industries.

It is worth to mention and deeply discuss the possibilities of bio degradable lubricants to replace the base oil lubricant and their importance in industries as well.

1.72.1 The relationship between the independent and the dependent variables

Oil industries are very essential for our lives almost everything around us is somehow made of oil refining, devices, furniture, plastic bottles clothes, detergents etc. but if there is any possibility to replace oil-based lubricants with a more human and environment friendly lubricants, this might reduce the risk of being exposed to oil products and reduce health risk. Also, it will reduce the risk of polluting environment

Chapter#3

Research Methodology

1.1. Introduction

In this chapter, I will explain the research methodology used in this project which will help answering the research questions clearly. Below topics will identify the operational definitions for the research variables:

3.1.1 Operational definitions for research variables:

In research studies, operational definitions are key in clearly defining the variables being measured. An operational definition describes how a variable will be measured, observed, or manipulated. It helps researchers ensure that their studies are consistent, reliable, and valid

3.1.2 Lubricants made of base oil (The independent variable#1):

Operational Definition: Based oil lubricant is essential for many industries machinery. their impact on health and environment is quite difficult to measure and control and as an independent variable we will figure out if it can be replaced with more environment friendly and less human health impact during long exposure and how to measure the severity and control the risk.

3.1.3 Bio degradable lubricant (The independent variable#2):

Although it is market value is around US \$ 1.4 Bn in 2021 and registering Y-o-Y growth of 4.9%. ([Market Study on Bio Lubricants: Rising Demand for Environmentally Friendly Lubricants to Augment Market Expansion \(persistencemarketresearch.com\)](https://www.persistencemarketresearch.com/market-research/bio-lubricants-market-report.asp)) However, it seems it is slowly spreading and not very popular within industries, we will measure how it might change the effect on human and the impact on environment if it can replace the oil fashioned oil-based lubricants.

3.1.4 Effects on health and environment, (The dependent variable#2):

a questionnaire was shared with a refinery employee to effectively measure the actual behavior and how effectively the Procedures & safety measures to control oil-based lubrication handling and exposure. In additions how, it can be enhanced to control, handling and minimize exposure.

3.1.5 Measuring the role of increasing the usage of bio-degradable lubricants (The dependent variable#2):

Possible impacts of widely spreading the awareness of bio-degradable lubricants and investing in manufacturing environment and health friendly lubricants products, a questionnaire was shared to a sample of a refinery employees asking about the future of bio-degradable lubricants.

1.2. Research design (Research Onion)

In this template, we'll present a structure that covers five important methodological matters (as outlined below). This structure is loosely based on "research onion".

1. Research philosophy (Positivist)

This research philosophy will concentrate on discovering the relation between the dependent variables and the independent variables, and understand the effect of each.

2. Research approach (Deductive)

The research approach aims to analyze the data and focus on the relation between each.

3. Research strategy (Survey)

The research strategy will include gathering information in the area of study

4. Research choice (Quantitative):

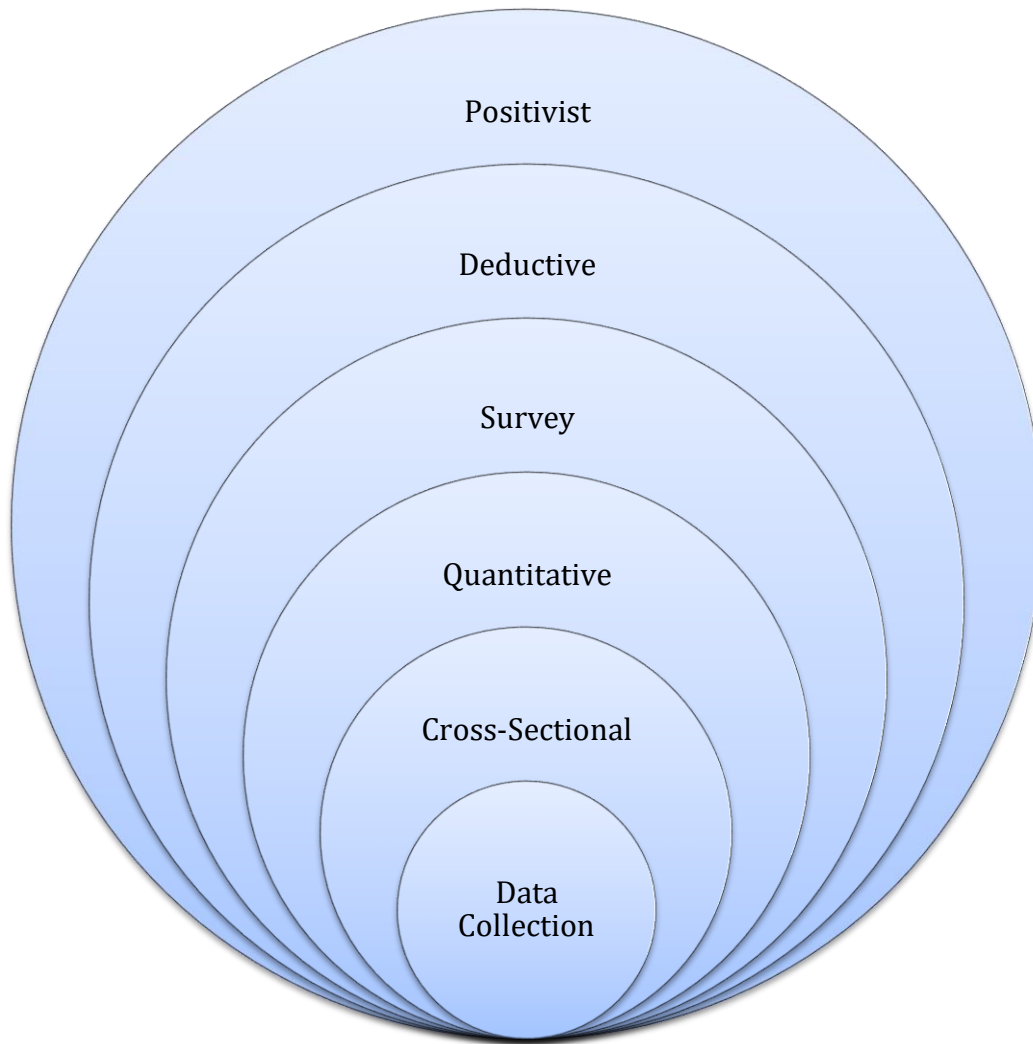
Research choice will be quantitative by collecting data empirically.

5. Time horizon (Cross-Sectional):

Collecting required research data will be within a defined time and limited timing.

6. Data collection and analysis techniques:

Data collection will utilize surveys and questionnaires.



1.3. Research population & Sampling methods and technique

This section provides information about the study population & sample, and this section demonstrates the methods and techniques that were elaborated in order to select the study sample, and determine the sample size.

3.3.2 Research Population مجتمع الدراسة

Research population will clarify and share detailed information about the population of the study, an oil refinery employee, their numbers and classifications.

Number of Employees	Classification(Job Title)
10	Senior Managers
20	Bachelor graduates (Engineers)
15	Supervisors
200	Technicians

3.3.3 Research Sample

This section will mention the detailed information of the study sample, size and their classifications.

Sample Size	Sample Classification
150-200	Oil Refinery Employees

3.3.4 Sampling Method & Techniques

At this section I have determine to choose technique and simple random sample method.

1.4. Data collection method

At the data collection method section, surveys were used to collect the required data.

The independent variable# 1&2 (Lubricants made of base oil) & (Bio degradable lubricant)

the researcher is relied on the questionnaire of Mark (2022). In order to measure the independent variable (**Lubricants made of base oil & Bio degradable lubricant**), in terms of three dimensions namely: health, environment, exposure

Table (3) for the instrument of the independent variable....

Variable 1 & 2	Dimensions	Number of Items	Sources
(Lubricants made of base oil) & (Bio degradable lubricant)	Health	4	(Mark, 2022)
	Environment	5	
	Exposure	4	
	Over all	13	

1.5. Types of data

In this section, you should differentiate between primary data and secondary data that were used in your project.

1.5.1.Primary data:

Primary data is the type of data that are essential for the research study and this data is the actual basis for the data collection.

1.5.2.Secondary data:

The secondary data is the type of data that is not mainly about the research study

1.6. Research instruments (Questionnaire):

Different types of lubricants and their effects on health and environment.

Dear Participant,

This Questionnaire is a part of final research project, and it is intended to evaluate the awareness of an oil refinery employees toward lubricants (petroleum based / Bio based) and their possible effect on health and environment.

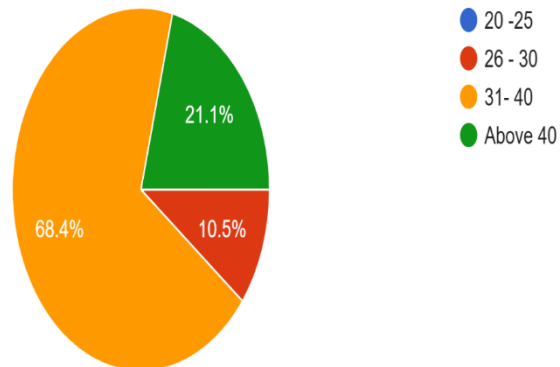
Thank you for your contribution

Gender*

Male
Female

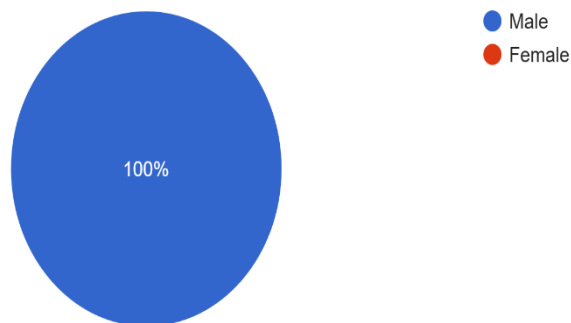
Age

19 responses



Gender

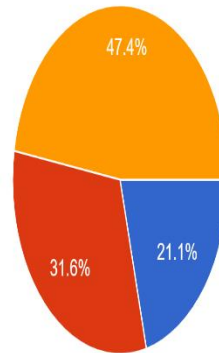
19 responses



Educational Level*

High school
Diploma
Bachelor
Other

Educational Level
19 responses

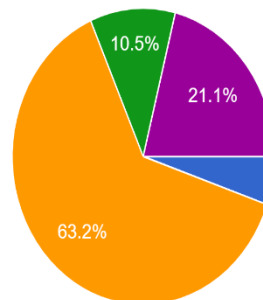


● High school
● Diploma
● Bachelor
● Other

Years of experience*

0 - 5 Years
6 - 10 Years
11- 15 Years
16 - 20 Years
More than 20 Years

Years of experience
19 responses

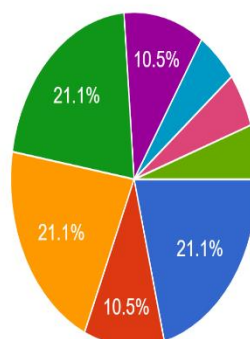


● 0 - 5 Years
● 6 - 10 Years
● 11- 15 Years
● 16 - 20 Years
● More than 20 Years

Current Job Title*

Maintenance Technician
Equipment Operator
Team leader
Engineer
Department or Division Head
Other:

Current Job Title
19 responses



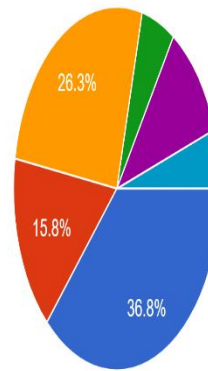
● Maintenance Technician
● Equipment Operator
● Team leader
● Engineer
● Department or Division Head
● Trainer
● Craft Supervisor
● Supervisor

How often are you exposed to lubricants?*

Daily
Once a Week
Once a Month
Every 3 Months
Never
Other:

How often are you exposed to lubricants?

19 responses



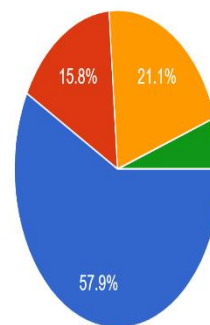
● Daily
● Once a Week
● Once a Month
● Every 3 Months
● Never
● Rarely based on job requirements

How often do you use lubricant handling PPEs*

Always
Sometimes
Rarely
Never

How often do you use lubricant handling PPEs

19 responses



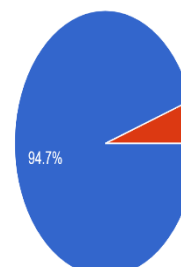
● Always
● Sometimes
● Rarely
● Never

Are you aware of Safety Data Sheet (SDS)?*

Yes
No

Are you aware of Safety Data Sheet (SDS)?

19 responses



● Yes
● No

Are you familiar with lubrication PPEs

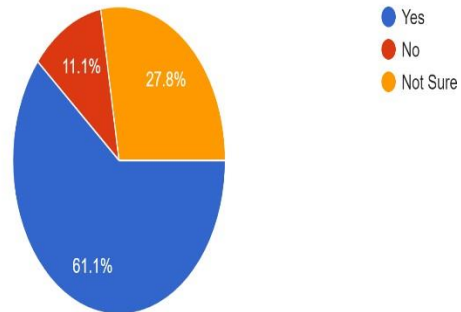
Yes

No

Not Sure

Are you familiar with lubrication PPEs

18 responses



Current health & environment safety measures are effective.*

Strongly Agree

Agree

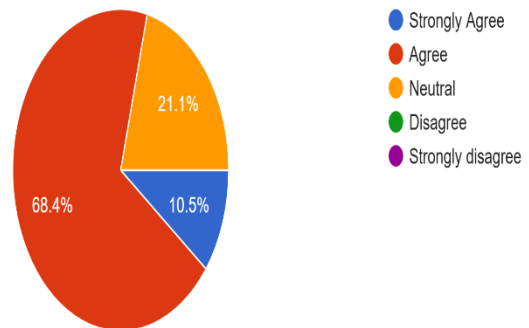
Neutral

Disagree

Strongly disagree

Current health & environment safety measures are effective.

19 responses



Have you ever heard about bio-degradable lubricants?*

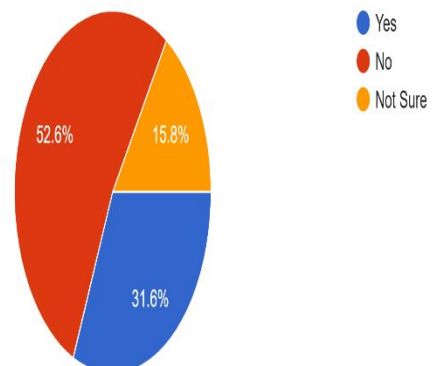
Yes

No

Not Sure

Have you ever heard about bio-degradable lubricants?

19 responses

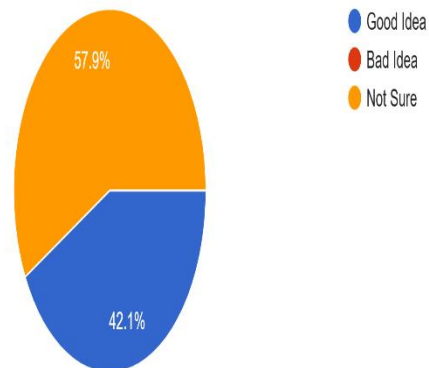


What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?*

Good Idea
Bad Idea
Not Sure

What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?

19 responses

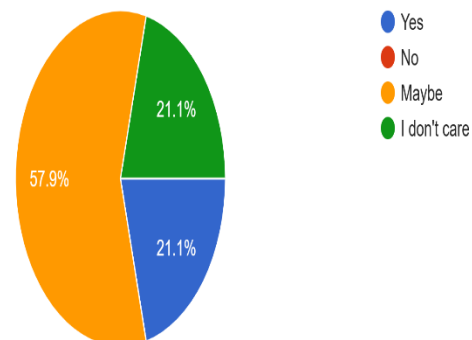


Do you think that bio-Lubricants will replace petroleum-based lubricants some day?*

Yes
No
Maybe
I don't care

Do you think that bio-Lubricants will replace petroleum-based lubricants some day?

19 responses

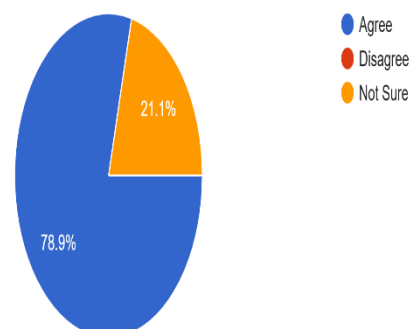


Waste oil is being disposed safely to prevent environmental pollution.*

Agree
Disagree
Not Sure

Waste oil is being disposed safely to prevent environmental pollution.

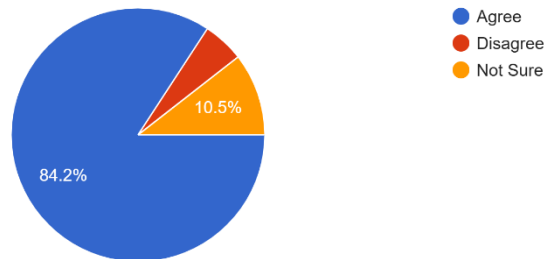
19 responses



Concerned individuals can get required lubricants handling tools.*

Agree
Disagree
Not Sure

Concerned individuals can get required lubricants handling tools.
19 responses



What do you think we can do to enhance lubricants handling and limit exposure risk?

Ensure 100% ppe compliance and sds available at storage
Building a clear system to handle all the requirement of lubrication starting from proper selection including storage and handling
We must train the ppl to learn the risk
Special tanks
Safety is value
Enhance now oil specifications and time life high
Using the required Resources PPE
More awareness
yes, we do.

Questionnaire link

<https://forms.gle/Ho6iUiAj5APb2cLx8>

1.7. Statistical analysis procedures

Factor Analysis

Descriptive Statistics				
	Mean	Std. Deviation	Analysis N	Missing N
How often are you exposed to lubricants?	1.70	.680	19	0
How often do you use lubricant handling PPEs	1.74	.991	19	0
Are you aware of Safety Data Sheet (SDS)?	1.05	.229	19	0
Are you familiar with lubrication PPEs	1.63	.895	19	0
Current health & environment safety measures are effective.	2.11	.567	19	0
Have you ever heard about bio-degradable lubricants?	1.84	.688	19	0
What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	1.58	.507	19	0
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	2.00	.667	19	0

Waste oil is being disposed safely to prevent environmental pollution.	1.21	.419	19	0
Concerned individuals can get required lubricants handling tools.	1.26	.653	19	0

Correlation Matrix^a

		How often are you exposed to lubricants?	How often do you use lubricant handling PPEs	Are you aware of Safety Data Sheet (SDS)?	Are you familiar with lubrication PPEs	Current health & environment safety measures are effective.	Have you ever heard about bio-degradable lubricants?
Correlation	How often are you exposed to lubricants?	1.000	.803	.108	.811	.555	.278
	How often do you use lubricant handling PPEs	.803	1.000	-.180	.573	.447	.099
	Are you aware of Safety Data Sheet (SDS)?	.108	-.180	1.000	.100	.382	.407
	Are you familiar with lubrication PPEs	.811	.573	.100	1.000	.628	.261
	Current health & environment safety measures are effective.	.555	.447	.382	.628	1.000	.472
	Have you ever heard about bio-degradable lubricants?	.278	.099	.407	.261	.472	1.000

	What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	.415	.320	.201	.618	.549	.117
	Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.276	.168	.000	.466	.588	.121
	Waste oil is being disposed safely to prevent environmental pollution.	.090	.275	-.122	.218	.369	-.071
	Concerned individuals can get required lubricants handling tools.	.002	-.144	-.098	.080	-.079	-.026
Sig. (1-tailed)	How often are you exposed to lubricants?		<.001	.330	<.001	.007	.125
	How often do you use lubricant handling PPEs	.000		.230	.005	.027	.344
	Are you aware of Safety Data Sheet (SDS)?	.330	.230		.342	.053	.042
	Are you familiar with lubrication PPEs	.000	.005	.342		.002	.140
	Current health & environment safety measures are effective.	.007	.027	.053	.002		.021

	Have you ever heard about bio-degradable lubricants?	.125	.344	.042	.140	.021	
	What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	.038	.091	.205	.002	.007	.316
	Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.127	.246	.500	.022	.004	.311
	Waste oil is being disposed safely to prevent environmental pollution.	.357	.128	.310	.185	.060	.386
	Concerned individuals can get required lubricants handling tools.	.497	.278	.346	.372	.374	.458

Correlation Matrix^a

		What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	Waste oil is being disposed safely to prevent environmental pollution.	Concerned individuals can get required lubricants handling tools.
Correlation	How often are you exposed to lubricants?	.415	.276	.090	.002

	How often do you use lubricant handling PPEs	.320	.168	.275	-.144
	Are you aware of Safety Data Sheet (SDS)?	.201	.000	-.122	-.098
	Are you familiar with lubrication PPEs	.618	.466	.218	.080
	Current health & environment safety measures are effective.	.549	.588	.369	-.079
	Have you ever heard about bio-degradable lubricants?	.117	.121	-.071	-.026
	What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	1.000	.657	.440	.353
	Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.657	1.000	.398	.128

	Waste oil is being disposed safely to prevent environmental pollution.	.440	.398	1.000	-.011
	B4	.353	.128	-.011	1.000
Sig. (1-tailed)	How often are you exposed to lubricants?	.038	.127	.357	.497
	How often do you use lubricant handling PPEs	.091	.246	.128	.278
	Are you aware of Safety Data Sheet (SDS)?	.205	.500	.310	.346
	Are you familiar with lubrication PPEs	.002	.022	.185	.372
	Current health & environment safety measures are effective.	.007	.004	.060	.374
	Have you ever heard about bio-degradable lubricants?	.316	.311	.386	.458

	What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?		.001	.030	.069
	Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.001		.046	.301
	Waste oil is being disposed safely to prevent environmental pollution.	.030	.046		.483
	Concerned individuals can get required lubricants handling tools.	.069	.301	.483	

a. Determinant = .002

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.508
Bartlett's Test of Sphericity	Approx. Chi-Square	88.148
	df	45
	Sig.	<.001

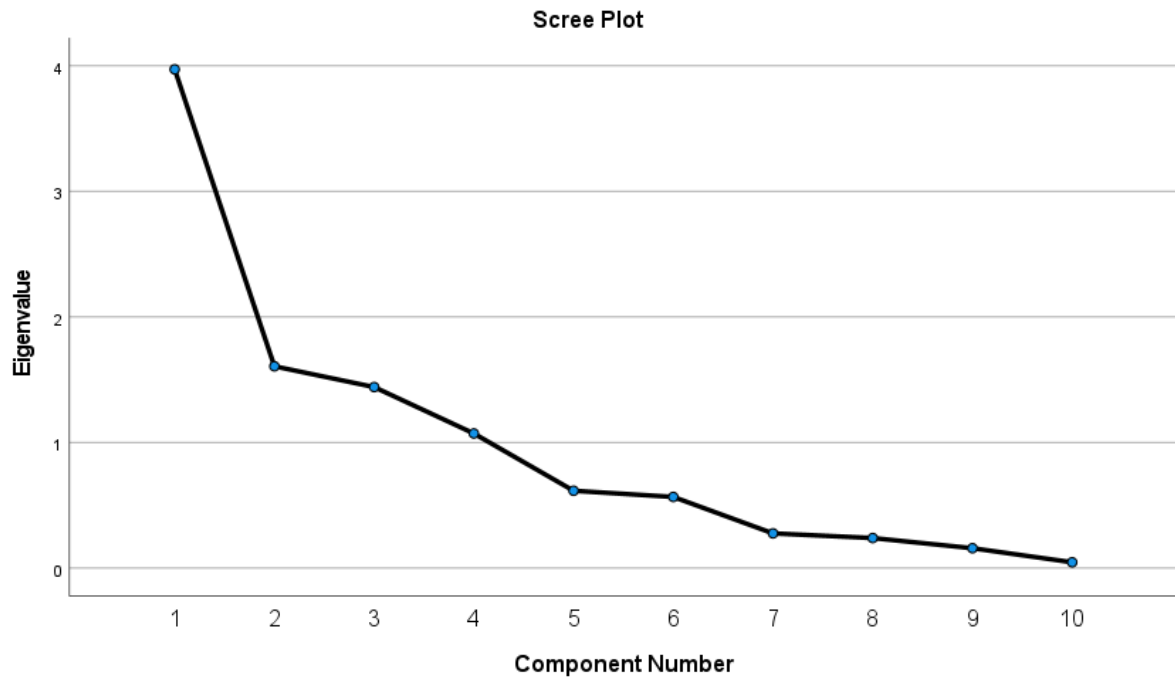
Communalities		
	Initial	Extraction
How often are you exposed to lubricants?	1.000	.936
How often do you use lubricant handling PPEs	1.000	.885
Are you aware of Safety Data Sheet (SDS)?	1.000	.758
Are you familiar with lubrication PPEs	1.000	.819
Current health & environment safety measures are effective.	1.000	.848
Have you ever heard about bio-degradable lubricants?	1.000	.637
What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	1.000	.833
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	1.000	.715
Waste oil is being disposed safely to prevent environmental pollution.	1.000	.765
Concerned individuals can get required lubricants handling tools.	1.000	.898

Extraction Method: Principal Component Analysis.

Total Variance Explained				
Component	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings		
	Cumulative %	Total	% of Variance	Cumulative %

Total Variance Explained					
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	3.972	39.720	39.720	3.972	39.720
2	1.607	16.073	55.793	1.607	16.073
3	1.442	14.420	70.213	1.442	14.420
4	1.072	10.724	80.937	1.072	10.724
5	.616	6.164	87.101		
6	.567	5.673	92.774		
7	.277	2.769	95.543		
8	.240	2.400	97.943		
9	.159	1.588	99.531		
10	.047	.469	100.000		

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Extraction Method: Principal Component Analysis.

Component Matrix ^a				
	Component			
	1	2	3	4
Are you familiar with lubrication PPEs	.865			
Current health & environment safety measures are effective.	.846			
How often are you exposed to lubricants?	.800		-.451	

What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	.770		.405	
How often do you use lubricant handling PPEs	.668		-.649	
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.663		.398	
Are you aware of Safety Data Sheet (SDS)?		.738	.403	
Have you ever heard about bio-degradable lubricants?	.382	.682		
Concerned individuals can get required lubricants handling tools.		-.350	.496	.724
Waste oil is being disposed safely to prevent environmental pollution.	.439	-.488		-.558

Extraction Method: Principal Component

Analysis.^a

a. 4 components extracted.

Rotated Component Matrix ^a				
	Component			
	1	2	3	4
How often are you exposed to lubricants?	.946			

How often do you use lubricant handling PPEs	.896			
Are you familiar with lubrication PPEs	.790	.343		
Waste oil is being disposed safely to prevent environmental pollution.		.819		
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?		.796		
What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	.332	.708		.436
Current health & environment safety measures are effective.	.468	.583	.529	
Are you aware of Safety Data Sheet (SDS)?			.863	
Have you ever heard about bio-degradable lubricants?			.769	
Concerned individuals can get required lubricants handling tools.				.941

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.^a

a. Rotation converged in 6 iterations.

Component Transformation Matrix				
Component	1	2	3	4
1	.726	.603	.314	.108
2	.018	-.426	.866	-.262
3	-.620	.453	.390	.509

4	.298	-.501	-.006	.813
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Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Frequencies

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	Cases Used	Statistics are based on all cases with valid data.
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17.

Statistics						
		Age	Gender	Education al Level	Years of Experience	Current Job Title
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0

Frequency Table

Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	26 - 30	2	10.0	10.0	10.0
	31-40	13	65.0	65.0	75.0
	Above 40	4	20.0	20.0	95.0
	Age	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

20.

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	19	95.0	95.0	95.0
	Gender	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

22.

Educational Level					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High school	4	20.0	20.0	20.0

	Diploma	6	30.0	30.0	50.0
	Bachelor	9	45.0	45.0	95.0
	Educational Level	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

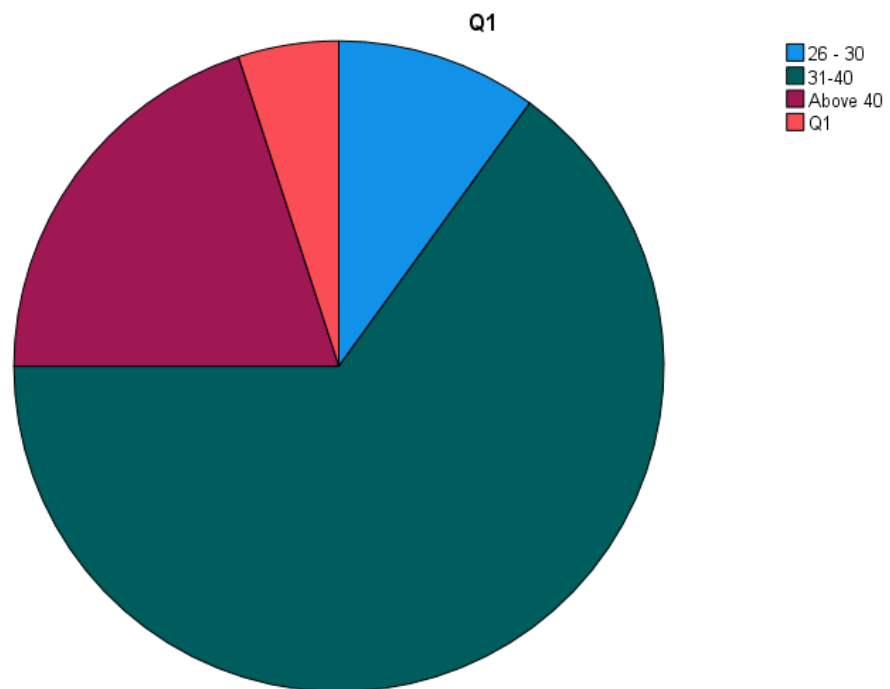
24.

Years of experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 5 Years	1	5.0	5.0	5.0
	11- 15 Years	12	60.0	60.0	65.0
	16 - 20 Years	2	10.0	10.0	75.0
	More than 20 Years	4	20.0	20.0	95.0
	Years of Experience	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

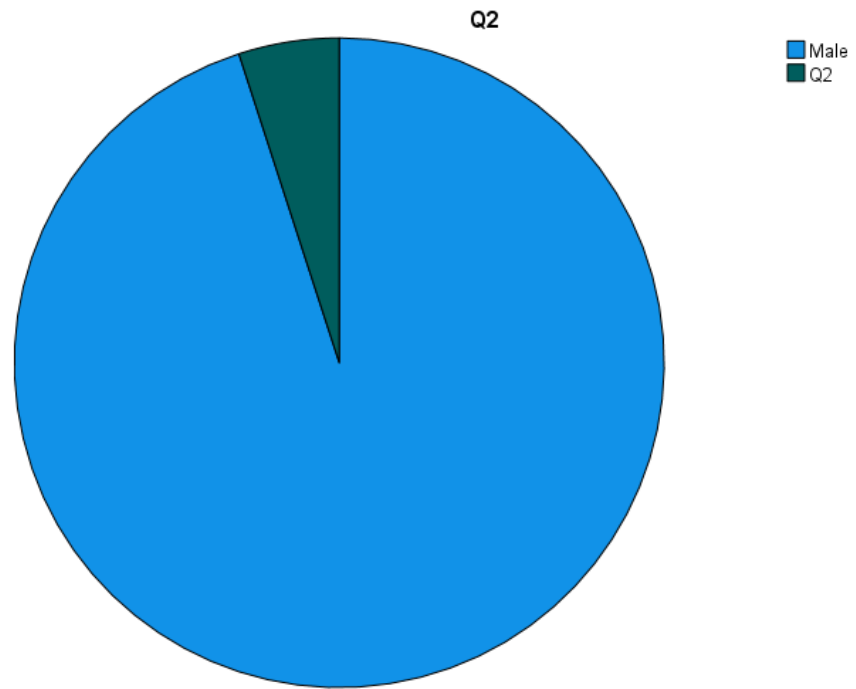
Current Job Title					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Maintenance Technician	4	20.0	20.0	20.0
	Engineer	4	20.0	20.0	40.0
	Team Leader	4	20.0	20.0	60.0
	Equipment Operator	2	10.0	10.0	70.0
	Crafts Supervisor	2	10.0	10.0	80.0
	Trainer	1	5.0	5.0	85.0
	Department or Devision Head	2	10.0	10.0	95.0
	Current Job Title	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Pie Chart

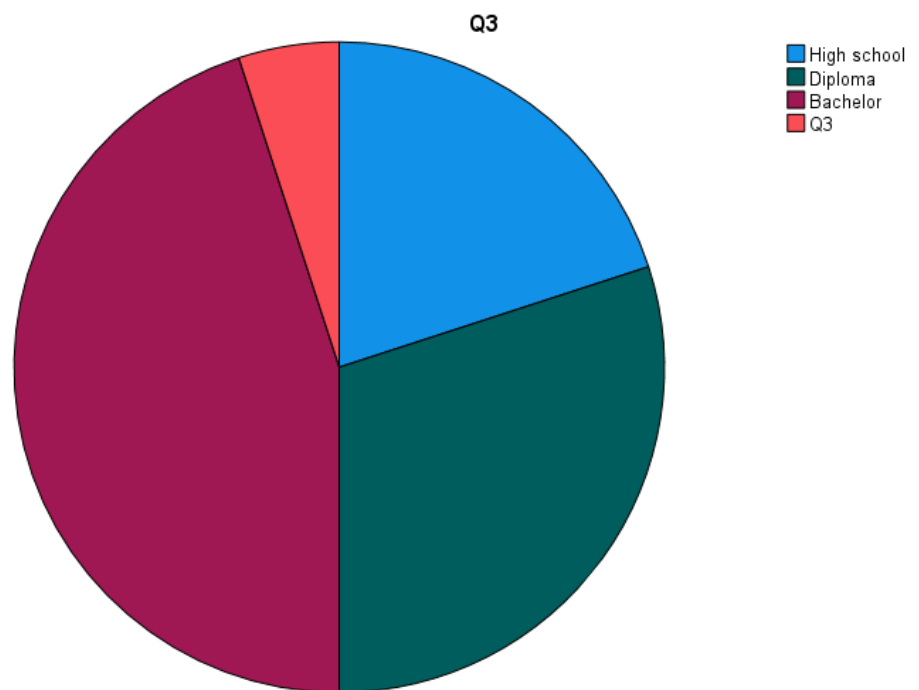
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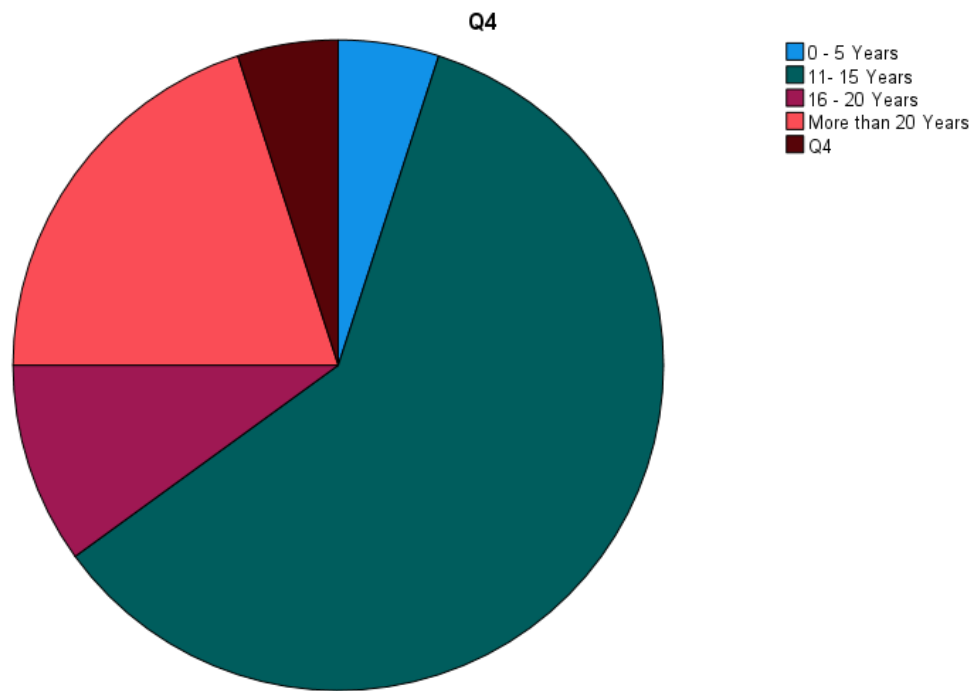
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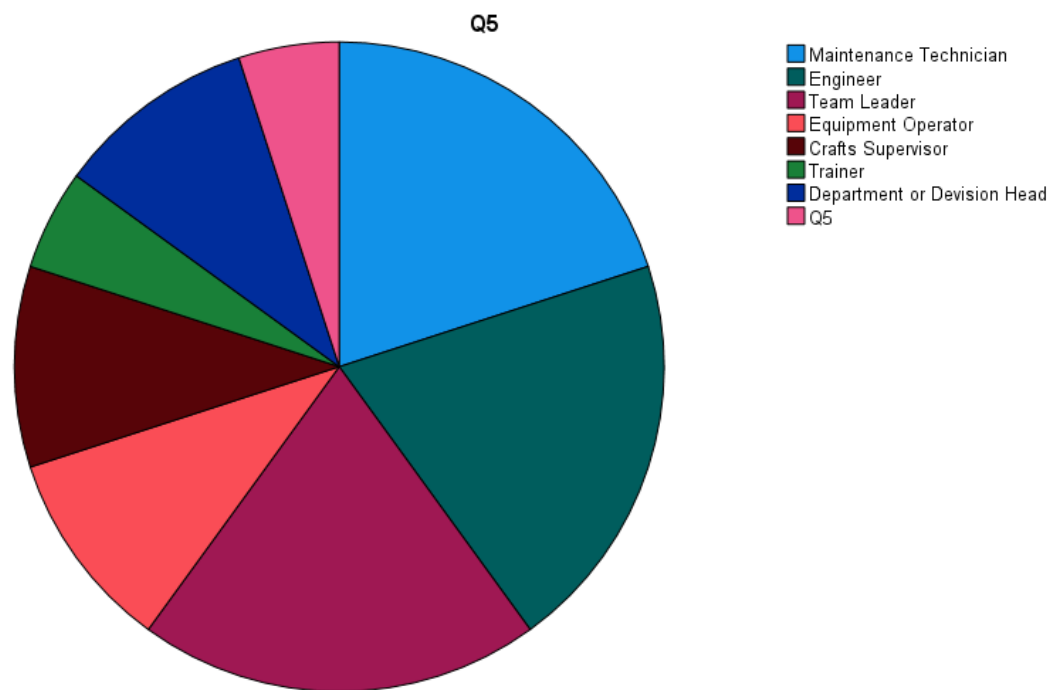
Educational Level



Years of Experience



Current Job Title



Descriptives

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Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
How often are you exposed to lubricants?	19	2	1	3	1.70	.156
How often do you use lubricant handling PPEs	19	3	1	4	1.74	.227

Are you aware of Safety Data Sheet (SDS)?	19	1	1	2	1.05	.053
Are you familiar with lubrication PPEs	19	2	1	3	1.63	.205
Current health & environment safety measures are effective.	19	2	1	3	2.11	.130
Have you ever heard about bio-degradable lubricants?	19	2	1	3	1.84	.158
What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	19	1	1	2	1.58	.116
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	19	2	1	3	2.00	.153
Waste oil is being disposed safely to prevent environmental pollution.	19	1	1	2	1.21	.096
Concerned individuals can get required lubricants handling tools.	19	2	1	3	1.26	.150

Descriptive Statistics		
	Std. Deviation	Variance
	Statistic	Statistic
How often are you exposed to lubricants?	.680	.462
How often do you use lubricant handling PPEs	.991	.982
Are you aware of Safety Data Sheet (SDS)?	.229	.053
Are you familiar with lubrication PPEs	.895	.801
Current health & environment safety measures are effective.	.567	.322
Have you ever heard about bio-degradable lubricants?	.688	.474
What do you think about replacing petroleum-based lubricants with bio-lubricants in machinery?	.507	.257
Do you think that bio-Lubricants will replace petroleum-based lubricants some day?	.667	.444
Waste oil is being disposed safely to prevent environmental pollution.	.419	.175
Concerned individuals can get required lubricants handling tools.	.653	.427

3.7 Conclusion

In conclusion, oil-based products and lubricant have contributed to change the world we know. However, I believe it is the time to try to develop and consider human health and environment as a priority, large

companies and manufacturers of lubricants have a huge responsibility in this matter to keep factories running and in the same time to invest more in researches regrading more efficient and safe lubricants products on humans and environment.

3.8 Reference list

1. (The History of Lubrication, [Jim Fitch](#), Noria Corporation)
2. .([Bennett Fitch](#), Noria Corporation)
3. ([Jonathan Trout](#), [Jim Fitch](#), Noria Corporation)
4. .([Bennett Fitch](#), Noria Corporation)
5. (Ramesh Chand & Binay Kumar, IJSET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 4, April 2017)
6. ([Market Study on Bio Lubricants: Rising Demand for Environmentally Friendly Lubricants to Augment Market Expansion \(persistencemarketresearch.com\)](#))

4. Error! Bookmark not defined. **Chapter 4: Statistical Analysis & Findings Discussion**

4.1 Introduction

This chapter clarifies and discusses the results of the field study that were statistically analyzed using the statistical programs SPSS version 28. The current chapter of statistical analysis includes descriptive statistics for the sample under study using SPSS version 28. Testing the validity and reliability of the questionnaires used to collect the required data from the current study sample. In order to test the research hypotheses and the suitability of the model, simple linear regression analysis was conducted via SPSS 28.

4.2 Characteristics of the study sample.

- The study sample was distributed according to gender - age group - number of years of experience - educational level and current job title.
- Frequencies and percentages were calculated for the study sample members and are represented by demographic information that includes:

- Gender includes (male, female).
- The age group includes (from 20 to 25 years, from 26 to 30 years, from 31 to 40 years, and more than 41 years).
- Number of years of experience, including (0 to 5 years, from 6 to 10 years, from 11 to 15 years, from 16 to 20 years , more than 20 years).
- Current job title , including (maintenance technicians /team leaders/ supervisors /trainer/ department or division heads) Educational level, includes (high school/diploma/bachelor).

4.3 Descriptive table for the study

Variable	Variable classes	The number	Percentage of the total sample
Gender الجنس	Male	20	100%
	Female	0	0%
	Total		100%
The age group	from 20 to 25 years	0	0
	from 26 to 30 years	2	10.5%
	from 31 to 40 years	13	68.4%
	more than 41 years	4	21.1%
	Total		100%
Number of years of experience	0 to 5 years	1	5.3%
	from 6 to 10 years	0	0%
	from 11 to 15 years	12	63.2
	from 16 to 20 years	2	10.5%
	more than 20 years	4	21.1%

	Total		100%
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4.4 Measuring the validity and reliability of study instruments

In order to verify the validity and reliability of the measures used in the study, the internal consistency validity of the questionnaires used to measure the study variables was tested, in addition to measuring the convergent validity by measuring the Average Variance Extracted (AVE). While the reliability of the measures used in the study was measured by Measuring the value of Cronbach's alpha, through the structural equation modeling (SEM), using the statistical analysis program **SPSS** version **28**. The following paragraphs and tables explain this.

4.5 *Validity of the measures used in the study*

The internal consistency validity of the scales used to measure the study variables was tested, in addition to measuring the convergent validity by measuring the average variance extracted.

Internal consistency validity: It means the extent to which each statement of the questionnaire is consistent with the variable to which it belongs. Therefore, the researcher measured the internal consistency of the questionnaires by calculating the correlation coefficients between the score of each statement and the total score of the variable to which it belongs. According to Kaiser (1974) study, a correlation coefficient of less than 0.5 is removed from the questionnaire.

Convergent Validity: The average variance between statements that measure the same scale is measured by calculating the average variance extracted (AVE), whose value must be greater than 0.5 according to Hair et al (2006).

The following tables show the statistical results for (correlation coefficients, standard deviation, calculated T value, and P value between the score of each statement and the total score of the variable to measure the validity of the internal consistency of the questionnaires. Also, calculating the value of the average variance extracted (AVE) to measure the convergent validity of the questionnaires through the equation model. Structural **SPSS** version **28**, as follows:

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.508
Bartlett's Test of Sphericity	Approx. Chi-Square	88.148
	df	45

Sig.

<.001

Variable المتغير		Statements العبارات	KMO	Factor loadings معامل الارتباط	Standard deviation التحرف المعياري	p Values	Average variance extracted متوسط التباين المستخرج	
First variable المتغير الأول	First dimension البعد الأول	A1		.946	.680	0.00		2.02
		A2		.896	.991	0.00		
		A3		.790	.229	0.00		
		A4		.819	.895			
	Second dimension البعد الثاني	B1		.796	.567	0.00		
		B2		.708	.688	0.00		
		B3		.769	.419	0.00		
		B4		.941	.653			
	Third dimension البعد الثالث	C1		.583	.567	0.00		
		C2		.863	.688	0.00		

We conclude from the table above that the scale of applying the first variable: All correlation coefficients for all statements are strongly correlated with their dependent variable (the variable and its dimensions), at values greater than 0.7. In addition, the values of all correlation coefficients for the statements are statistically significant at a significance level less than 0.001. Accordingly, the internal consistency validity of the scale has been achieved. Also, from the results above related to the value of the average variance extracted AVE, it is clear that its value for the variable of applying (the variable and its dimensions) is $0.565 > 0.5$. Accordingly, the convergent validity of the questionnaire has been achieved. The scale of applying the second variable: All correlation coefficients for the statements that measure (the variable and its dimensions) have a value greater than 0.991. In addition, the values of all correlation coefficients for the statements are statistically significant at a significance level less than 0.0001. Accordingly, the internal consistency validity of the scale has been achieved in its three dimensions. Also, from the results above related to the value of the average variance extracted AVE for the variable of (the variable and its dimensions) as a whole, which is equal to **2.02**, the values of the average variance extracted (for the dimensions of the variable) are: 0.770, 0.0758, respectively. Accordingly, the convergent validity of the questionnaire has been achieved.

4.5 Conclusion:

There is a positive relationship with statistical significance between the independent variable and the dependent variable (We mention the result of the research hypotheses in full)

5. Findings Discussion and Conclusion

5.1 Introduction : This chapter deals with the of the study, in addition to the Recommendations, study's limitations, Future studies, and the conclusion.

5.2 Recommendations In light of the study results, the researcher recommends the following:

- The necessity of raising awareness about the concept of Biodegradable based lubricants
- The necessity of encouraging managers to use Safety procedures for lubricants handling strictly
- The necessity of providing continues awarenesses and training
- There is still a huge need for further research and practical experiment on biodegradable efficiency to look if it can really substitute oil based lubricants

5.3 Objective Boundaries: The study is limited to stating the reality of management with the first variable and its dimensions, with mentioning the dimensions, and the second variable with its dimensions, with mentioning the dimensions.

5.4 Human Boundaries: The study is limited to the employees in the Oil & Gas sector that considers lubrication is very essential to the operations

5.5 Spatial Boundaries: The study is limited to an oil refinery the western region of Saudi Arabia