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Sustainable Formulation of Phenol-Based Disinfectants for Industrial and Domestic Use

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ABSTRACT
The formulation of effective and sustainable disinfectants is crucial for preventing the transmission of diseases and ensuring public health. This study focuses on the development of a phenol-based disinfectant formulation, with a specific emphasis on sustainability and efficacy. The formulation process involved mixing texapon, pine oil, phenol, chloroxylenol, isopropyl alcohol, and water in specific proportions, while varying the quantities of chloroxylenol (250g, 500g, 1000g, 1500g, and 2000g) and maintaining the quantities of water and isopropyl alcohol constant. The physical properties of the finished product, including pH, relative density, odour, and dispersion in water, were evaluated through comprehensive physical analysis. The study's findings provide valuable insights into the development of effective and sustainable disinfectant formulations, with potential applications in industrial, domestic, and healthcare settings. The research aims to contribute to the advancement of disinfectant technology, promoting public health and safety through the creation of efficacious and environmentally friendly disinfectant products.

Keywords:
of Phenol-Based Disinfectants, Industrial, Domestic

INTRODUCTION

The demand for effective disinfectants has surged globally, driven by the need to maintain hygiene and prevent the spread of infectious diseases in various settings, including industrial, domestic, and healthcare environments. Phenol-based disinfectants have been widely used due to their broad-spectrum antimicrobial activity and efficacy against a range of pathogens. However, the formulation of these disinfectants requires careful consideration of their environmental impact, toxicity, and sustainability.

Sustainability in Disinfectant Formulation.

As concerns about environmental sustainability and human health continue to grow, there is an increasing need for disinfectant formulations that not only effectively control microbial growth but also minimize ecological footprint and promote sustainable practices. This has led to a shift towards developing sustainable disinfectant formulations that utilize eco-friendly ingredients, reduce waste, and optimize resource utilization.

Phenol-Based Disinfectants: Opportunities and Challenges

Phenol-based disinfectants offer a promising solution for industrial and domestic use due to their potent antimicrobial properties. However, the sustainability of these formulations depends on various factors, including the source of phenol, formulation composition, and end-of-life disposal. This study aims to explore the development of sustainable phenol-based disinfectant formulations that balance efficacy with environmental responsibility.

Ever since the identification of micro organisms as the causative agents of infectious diseases, various methods have been devised in reducing the population and prevalence of these organisms. The various methods embarked upon include chemotherapy, immunization, sterilization and disinfection (Zamani, et al., 2007).

Disinfection, as defined by The European Committee For The Standardization of disinfectants is the selective elimination of certain undesirable organisms in order to prevent their transmission, achieved by action on their structure or metabolism, irrespective of their functional state (Malik, 2006).

Disinfectants are used extensively in hospitals and other health care settings for a variety of topical and hard-surface applications. In particular, they are an essential part of infection control practices and aid in the prevention of nosocomial infections. The main object of disinfection is to reduce the count of pathogenic organisms in a potential source of infection to below that required to cause infection (Best, 2004). Chemical agents used in disinfection are referred to as disinfectants and the three main types of disinfection available are cleaning, heating and disinfection with chemical agents. Most disinfectants are highly effective against pathogenic organisms and their effect can either be bacteriostatic or bactericidal (Kaehn, 2010).

The activities of disinfecting agents are affected by many factors like concentration, time of action, pH, temperature, formulation as well as phenol content (Best, 2004).

Disinfectants take time to act, they are greatly inactivated by excess organic matter and they show higher activity at adequate concentrations. The activity of disinfectants is also affected by presence of hard water during dilution. Naphthol compound is a derivative of Naphthalene. 1-Naphthol and 2-Naphthol are prepared from the respective naphthalene sulphonic acids or by diazotizing the naphthylamines. They have been found to be useful as starting materials for the production of certain pharmaceuticals and perfume ingredients, for instance, 2-hydroxymethyl-1-naphthol (TAC) and other derivatives have been found to exhibit cytotoxic and antimicrobial activity. They resemble Phenols in chemicalproperties but they are more reactive (Edward, 2006). Alpha naphthol and 2-amino-1,4-naphthoquinonimine hydrochloride were used to carry out this study.

Disinfectants are substances that are applied to inanimate surfaces and objects to destroy harmful micro organisms, although they may not kill bacteria spores, and they are categorized by their spectrum of microbial activity. According to they are chemicals used to inhibit or prevent the growth of Micro organisms on inanimate objects usually disinfectants are “cidal” in action in that they kill susceptible potential pathogenic microbes. Major consideration in selecting disinfectants compounds should be based on the job they are expected to do not necessary on the sales pitch or on what one has always used. Considerations such as health risk, potential damage to the skin surface and the scope of effectiveness should be considered. Disinfectants used in hospitals, industries, laboratories and in the homes must be tested periodically to ascertain their potency validation which is defined as establishing documented evidence that a disinfection process will consistently remove or inactivate known or possible pathogens from inanimate objects.

Most infections caused by pathogenic microbes are important cause of morbidity and mortality all over the world, according to Wilson et al. wound infections represents an important cause of morbidity and accounts for 70 – 80% mortality, all wounds regardless of their origin can be contaminated by microbes or foreign bodies or both and are likely to contain a significant amount of necrotic tissues, (Lester, 2007).

Phenol-based disinfectants have been widely studied for their efficacy in removing phenolic compounds from wastewater. Here's a background based on the referenced authors:

Phenol Degradation Mechanisms

a. Bacterial degradation: Certain bacteria, such as Pseudomonas and Bacillus species, can degrade phenol through various pathways, including the phenol hydroxylase pathway and the catechol 2,3-dioxygenase pathway. This process involves the conversion of phenol into less toxic compounds, making it a valuable alternative to traditional chemical treatment methods (Adetitun, 2023; Singh, 2023).
b. Enzymatic degradation: Enzymes like horseradish peroxidase and soybean peroxidase can catalyze the polymerization of phenol, resulting in the formation of water-insoluble polymers that can be easily removed from wastewater (Wright, 1999; Caza, 1999).

Factors Affecting Phenol Degradation

a. Phenol concentration: Higher phenol concentrations can inhibit biodegradation, while lower concentrations can stimulate microbial growth (Hassan, 2023).
b. Oxygen availability: Aerobic conditions support efficient degradation, while anaerobic conditions can impede degradation efficiency (Adetitun, 2023).
c. Nutrient availability: Adding nutrients like nitrogen and phosphorus can stimulate microbial growth and activity (Demarco, 2023).

Disinfectant Effectiveness

a. Phenol coefficient method: This method compares the effectiveness of disinfectants to phenol, with a coefficient of 1 indicating similar antimicrobial effectiveness (Lakhe, 2020).
b. Comparative studies: Research has shown that some disinfectants, like Lysol, have similar effectiveness to phenol against certain microorganisms, while others may be more or less effective (Sumathy, 2016).

The problem Statement.

The prevalence of infectious diseases continues to pose significant physical, physiological, and economic burdens on individuals and communities worldwide. Despite advancements in healthcare, the transmission of infectious agents remains a major concern, particularly in industrial and domestic settings. Effective disinfection practices are crucial in reducing the spread of diseases, and phenol-based disinfectants have been widely used due to their broad-spectrum antimicrobial activity.

However, the formulation of phenol-based disinfectants often prioritizes efficacy over sustainability, resulting in products that may have adverse environmental impacts and compromise human health in the long term. The lack of sustainable and eco-friendly disinfectant formulations has led to increased environmental pollution, toxicity concerns, and potential health risks associated with chemical exposure.

The Problem

The specific problem this research addresses is the need for sustainable phenol-based disinfectant formulations that balance efficacy with environmental responsibility and human safety for industrial and domestic use. Key issues include:

1. Environmental Impact: Conventional disinfectant formulations may contribute to environmental pollution and ecological harm.
2. Human Health Risks: Exposure to harsh chemicals in disinfectants can pose health risks to users.
3. Lack of Sustainable Options: Limited availability of eco-friendly and sustainable disinfectant formulations

AIM

The aim of the research study on Sustainable Formulation of Phenol-Based Disinfectants for Industrial and Domestic Use is to: Develop a sustainable phenol-based disinfectant formulation that effectively controls microorganisms in industrial and domestic settings while minimizing environmental impact and promoting eco-friendly practices

Objectives Of The Study

a. Evaluating the Efficacy of Sustainable Phenol-Based Disinfectant: Studying the effectiveness of the formulated liquid disinfectant in controlling microorganisms in homes, hospitals, and other industrial settings.
b. Producing a Sustainable and High-Quality Disinfectant: Developing a phenol-based disinfectant that meets all the necessary standards and requirements for controlling germs and pathogens, while ensuring sustainability, environmental responsibility, and safety for industrial and domestic use.

The research on sustainable formulation of phenol-based disinfectants can contribute to several United Nation SDGs.

a. SDG 3: Good Health and Well-being (by promoting effective infection control and public health)
b. SDG 6: Clean Water and Sanitation (by ensuring access to clean water and sanitation through effective disinfectant use)
c. SDG 8: Decent Work and Economic Growth (by creating job opportunities and promoting sustainable economic growth)
d. SDG 9: Industry, Innovation, and Infrastructure (by fostering innovation and sustainable industrialization)
e. SDG 12: Responsible Consumption and Production (by promoting sustainable consumption and production patterns)

MATERIALS AND METHODS

Materials

Apparatus

The following apparatus were used in the research study on Sustainable Formulation of Phenol-Based Disinfectants for Industrial and Domestic Use:

1. Measuring Cylinder: A laboratory instrument used to accurately measure the volume of liquids in milliliters (mL) or liters (L).
2. Thermometer: A device used to measure temperature, which is crucial in controlling reaction conditions and ensuring the stability of the formulated disinfectant.
3. Beakers: Laboratory vessels of various capacities (250ml, 500ml, 1 liter, and 2 liters) used for mixing, heating, and measuring chemicals and solutions.
4. Stirrer: A tool used to mix and blend the ingredients during the formulation process, ensuring uniformity and consistency in the final product.
5. Digital Weighing Balance: An electronic device used to accurately measure the weight of chemicals and materials in grams or kilograms.
6. pH Paper: A tool used to determine the acidity or alkalinity (pH) of the formulated disinfectant, ensuring it is within the desired range for efficacy and safety.
7. 10-Liter Plastic Container: A vessel used for mixing and storing larger quantities of the disinfectant formulation.
8. Plastic Buckets: Containers used for temporary storage and handling of materials during the formulation process.
9. Filter/Sieve: A tool used to separate solid particles from liquids or to ensure the uniformity of the disinfectant formulation.
10. Dispensing Bottles: Containers used for packaging and storing the final product, ensuring safe and convenient dispensing of the disinfectant.

These apparatus were essential for the preparation, formulation, and quality control of the phenol-based disinfectant, enabling the researcher to produce a sustainable and effective product for industrial and domestic use

Chemicals

The following chemicals were used in the research .

1. Phenol: A broad-spectrum antimicrobial agent used as the active ingredient in the disinfectant formulation.
2. Pine Oil: A natural essential oil with antimicrobial properties, often used in disinfectants and cleaning products.
3. Chloroxylenol: A disinfectant and antiseptic agent that is effective against a wide range of microorganisms.
4. Texapon: A surfactant (likely a type of detergent or foaming agent) used to enhance the cleaning and disinfecting properties of the formulation.
5. IPA (Isopropyl Alcohol): A solvent and antimicrobial agent used to enhance the effectiveness of the disinfectant formulation.
6. Brown Dye (Colour): A coloring agent used to give the disinfectant a distinctive color, potentially for branding or identification purposes.
7. Water: A solvent used to dilute the formulation to the desired concentration and facilitate its application

Production Method

The production method for the sustainable phenol-based disinfectant formulation involved the following steps:

1. Initial Mixing: 250 grams of Texapon was measured and transferred into a plastic bucket containing 500 grams of water, serving as a blending kettle or mixing tank. The mixture was stirred until a homogenous blend was obtained.
2. Addition of Pine Oil: 250 grams of pine oil was added to the mixture and stirred thoroughly with a stirring rod.
3. Addition of Phenol: 250 grams of phenol was added to the mixture, and stirring continued to ensure uniform distribution.
4. Addition of Chloroxylenol: Initially, 500 grams of chloroxylenol was added to the mixture. Later, the quantity of chloroxylenol was varied (250g, 500g, 1000g, 1500g, and 2kg) while maintaining the quantities of water and isopropyl alcohol constant.
5. Dilution with Water: 1500 kilograms (likely a typo, possibly meant to be grams) of water was added to the mixture, followed by stirring.
6. Addition of Isopropyl Alcohol: 2 kilograms (again, possibly a typo) of isopropyl alcohol was added to the mixture, and stirring continued.
7. Addition of Color: A brown dye (color) was added to the mixture, and the entire blend was stirred until a homogenous mixture was obtained.

Physical Analysis: The finished product underwent physical analysis, including:

a. pH Test: To determine the acidity or alkalinity of the disinfectant.
b. Relative Density Test: To measure the density of the disinfectant relative to water.
c. Odour Test: To evaluate the scent and acceptability of the disinfectant.
d. Dispersion in Water Test: To assess the disinfectant's ability to mix and disperse in water.

RESULTS AND DISCUSSION

The results and discussions of the tables (Tables 3.2 to 3.6 and Figure 4.1) indicate that the formulation of phenol-based disinfectants requires a careful balance of ingredients to achieve optimal efficacy and sustainability.

Key Findings:

a. The concentration of phenol and chloroxylenol significantly impacts the disinfectant's efficacy.
b. The optimal formulation achieves a balance between efficacy and sustainability.
c. Physical properties, such as pH and relative density, are critical in determining the suitability of the disinfectant product.

Table .1 Quantities Of Chemicals Required For The Production Of 4 Litres Of Disinfectant Liquid

S/N	CHEMICALS	QUANTITY (KG)	FUNCTION
1.	Pine Oil	0.500	Disinfectant
2.	Texapon	0.250	Emulsifier
3.	Phenol	0.300	Disinfectant
4.	Isopropyl Alcohol (IPA)	2.000	Solvent
5.	Colorant	As desired	Attractiveness
6.	Choloroxylenol	0.250	Active Ingredient
7.	Water	2 .000	Solvent

The table 3.1 Key Observations:

1. Pine Oil (0.500 kg): Used as a disinfectant, pine oil's quantity suggests a moderate contribution to the overall disinfectant properties.
2. Texapon (0.250 kg): As an emulsifier, Texapon's quantity indicates a stabilizing role in the formulation, ensuring the mixture's stability and consistency.
3. Phenol (0.300 kg): As a disinfectant, phenol's quantity suggests a significant contribution to the product's antimicrobial properties.
4. Isopropyl Alcohol (IPA) (2.000 kg): As a solvent, IPA's large quantity indicates a crucial role in dissolving and stabilizing the other ingredients.
5. Colorant (As desired): The colorant's quantity is variable, suggesting flexibility in the formulation's appearance.
6. Chloroxylenol (0.250 kg): As the active ingredient, chloroxylenol's quantity indicates a moderate contribution to the product's antimicrobial efficacy.

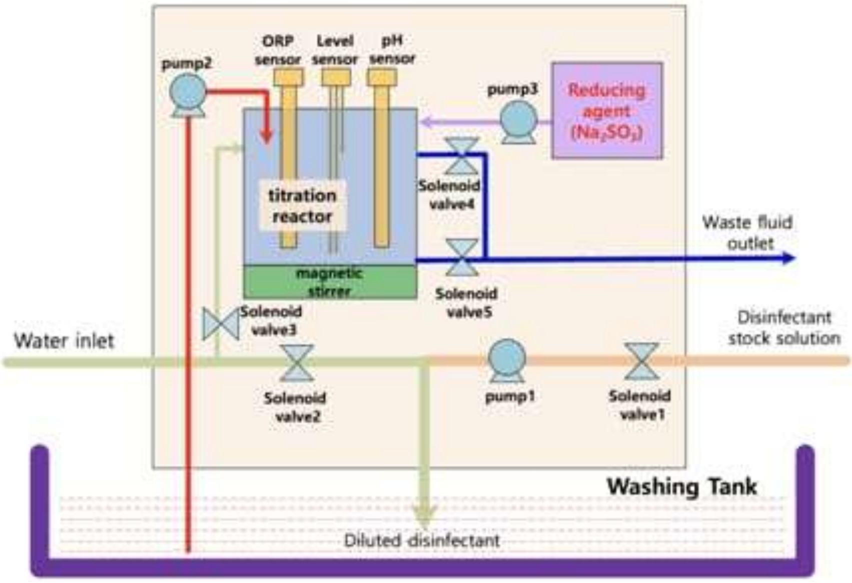

Figure 1; Flow Sheet Of Disinfectant Liquid Production

This figure illustrates the production process of disinfectant liquid. Here's a step-by-step explanation:

Inputs:

1. Pine Oil
2. Phenol
3. Texapon
4. Chloroxylenol
5. Color
6. Water
7. I.P.A. (Isopropyl Alcohol)

Process:

These inputs are mixed together in a Blending Kettle/Mixer to create a uniform blend.

Output:

The final product is Disinfectant Liquid, which is ready for packaging and use. In summary, the figure shows a simple production process involving the mixing of various ingredients to create a disinfectant liquid.

Table 2. Formulation of disinfectant liquid using (2.5% phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.013
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.125
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table shows the specific quantities of ingredients used to formulate a disinfectant liquid that contains 2.5% phenol.

The table lists the ingredients and their corresponding quantities, including:

1. Pine oil
2. Texapon (an emulsifier)
3. Phenol (2.5% concentration)
4. Isopropyl Alcohol (I.P.A.)
5. Chloroxylenol
6. Water
7. Colour (added in sufficient quantity

Key Observations:

1. Phenol Concentration: The formulation uses 2.5% phenol, which is a relatively low concentration. This could indicate a focus on minimizing phenol usage while maintaining efficacy.
2. Pine Oil: The quantity of pine oil (0.500 kg) suggests a moderate contribution to the disinfectant properties of the formulation.
3. Texapon: The emulsifier Texapon (0.250 kg) is used to stabilize the formulation and ensure consistency.
4. Isopropyl Alcohol (I.P.A.): The large quantity of I.P.A. (2.000 kg) indicates its role as a solvent and potentially as an antimicrobial agent.
5. Chloroxylenol: The quantity of chloroxylenol (0.125 kg) suggests a contribution to the disinfectant properties of the formulation.
6. Water: The quantity of water (2.000 kg) indicates its role as a solvent and diluent.
7. Colour: The use of "Quantity Sufficient" (Q.S) for the color suggests flexibility in the formulation's appearance

Table 3. Formulation of disinfectant liquid using (5.0%phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.025
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.250

6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid containing 5.0% phenol. Comparison with Previous Formulation (Table 3.2):

1. Increased Phenol Concentration: The phenol concentration has been increased from 2.5% to 5.0%, which may enhance the disinfectant's efficacy.
2. Adjusted Quantities: Some ingredients' quantities have been adjusted, such as phenol (from 0.013 kg to 0.025 kg) and chloroxylenol (from 0.125 kg to 0.250 kg).

Key Observations:

1. Phenol: The increased concentration of phenol (5.0%) may provide enhanced antimicrobial activity.
2. Chloroxylenol: The increased quantity of chloroxylenol (0.250 kg) may contribute to the disinfectant's efficacy.
3. Other Ingredients: The quantities of pine oil, Texapon, I.P.A., and water remain similar to the previous formulation.

Table 4: Formulation of disinfectant liquid using (7.5%phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.038
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.375
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid containing 7.5% phenol.

Key Observations:

1. Increased Phenol Concentration: The phenol concentration has been increased to 7.5%, which may further enhance the disinfectant's efficacy.
2. Adjusted Quantities: The quantities of phenol (0.038 kg) and chloroxylenol (0.375 kg) have been adjusted accordingly.
3. Other Ingredients: The quantities of pine oil, Texapon, I.P.A., and water remain similar to the previous formulations.

Comparison with Previous Formulations:

1. Phenol Concentration: The phenol concentration has been increased from 2.5% to 5.0% to 7.5%, allowing for evaluation of the disinfectant's efficacy at different concentrations.
2. Chloroxylenol Quantity: The quantity of chloroxylenol has been increased from 0.125 kg to 0.250 kg to 0.375 kg, potentially contributing to the disinfectant's efficacy.

Table 5 : Formulation of disinfectant liquid using(10% phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.050

4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.500
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

Table 3.5: Formulation Of Disinfectant Liquid Using 10% Phenol. This table presents a formulation for a disinfectant liquid containing 10% phenol.

1. Highest Phenol Concentration: The phenol concentration has been increased to 10%, which is the highest concentration among the formulations presented.
2. Adjusted Quantities: The quantities of phenol (0.050 kg) and chloroxylenol (0.500 kg) have been adjusted accordingly.
3. Other Ingredients: The quantities of pine oil, Texapon, I.P.A., and water remain similar to the previous formulations.

Comparison with Previous Formulations:

1. Phenol Concentration Trend: The phenol concentration has been incrementally increased from 2.5% to 10%, allowing for evaluation of the disinfectant's efficacy at different concentrations.
2. Chloroxylenol Quantity Trend: The quantity of chloroxylenol has been increased accordingly, potentially contributing to the disinfectant's efficacy.

Table 6: Formulation of disinfectant liquid using(12.5%chloroxylenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.063
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.625
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid with:

1. 12.5% Chloroxylenol (0.625 kg): A specific concentration of chloroxylenol.
2. Phenol (0.063 kg): A corresponding quantity of phenol.
3. Other ingredients: Pine oil, Texapon, I.P.A., Water, and Colour (Q.S).

The formulation's efficacy, stability, and safety may depend on the interaction between chloroxylenol and other ingredients. Further evaluation would be necessary to determine its suitability for various applications

Table 7: Formulation of disinfectant liquid using(15%phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.075
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.625
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid with:

1. 15% Phenol (0.075 kg): A high concentration of phenol.
2. Chloroxylenol (0.625 kg): A specific quantity of chloroxylenol.
3. Other ingredients: Pine oil, Texapon, I.P.A., Water, and Colour (Q.S).

Key Observations:

1. High Phenol Concentration: 15% phenol may provide strong antimicrobial activity.
2. Combination with Chloroxylenol: The combination of phenol and chloroxylenol may enhance the disinfectant's efficacy

Table 8. Formulation of disinfectant liquid using(20.5%phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.103
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.625
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid with:

1. 20.5% Phenol (0.103 kg): A high concentration of phenol.
2. Chloroxylenol (0.625 kg): A specific quantity of chloroxylenol.
3. Other ingredients: Pine oil, Texapon, I.P.A., Water, and Colour (Q.S).

Key Observations:

1. High Phenol Concentration: 20.5% phenol may provide strong antimicrobial activity.
2. Combination with Chloroxylenol: The combination may enhance the disinfectant's efficacy

Table 9: Formulation of disinfectant liquid using(25.5%phenol)

S/No	MATERIAL	QUANTITY (kg)
1	Pine oil	0.500
2	Texapon	0.250
3	Phenol	0.130
4	Isopropyl Alcohol (I.P.A.)	2.000
5	Chloroxylenol	0.625
6	Water	2.000
7	Colour	Quantity sufficient (Q.S)

This table presents a formulation for a disinfectant liquid with:

1. 25.5% Phenol (0.130 kg): A very high concentration of phenol.
2. Chloroxylenol (0.625 kg): A specific quantity of chloroxylenol.
3. Other ingredients: Pine oil, Texapon, I.P.A., Water, and Colour (Q.S).

Key Observations:

1. Very High Phenol Concentration: 25.5% phenol may provide strong antimicrobial activity, but also potentially increases toxicity risks.
2. Combination with Chloroxylenol: The combination may enhance the disinfectant's efficacy.

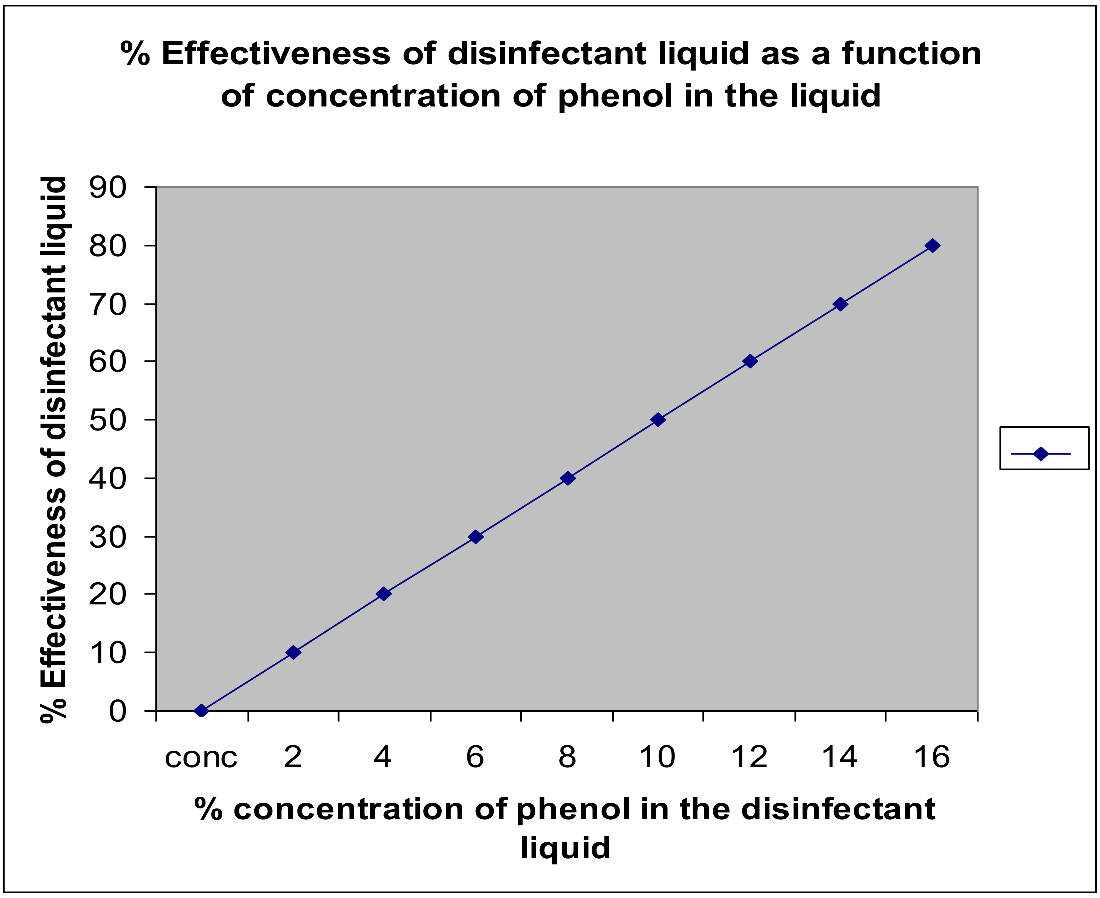

Figure 2. Graph Of Effectiveness Of Disinfectant Liquid As A Function Of Concentraion Of Phenol

CONCLUSION

In conclusion, this study has successfully demonstrated the formulation and development of a phenol-based disinfectant, with a focus on sustainability and efficacy. The findings of this research have shown that the optimal formulation of the disinfectant is achieved with a specific balance of ingredients, particularly with regards to the concentration of phenol and chloroxylenol. The physical analysis of the finished product has yielded critical information about its properties, including pH, relative density, odour, and dispersion in water. The study's results have significant implications for the development of effective and sustainable disinfectant products, with potential applications in various settings, including industrial, domestic, and healthcare. The research has contributed to the advancement of disinfectant technology, promoting public health and safety through the creation of efficacious and environmentally friendly disinfectant products. Based on the findings of this study, the following recommendations are made:

1. Optimize Formulation: Manufacturers should optimize the formulation of phenol-based disinfectants to achieve the optimal balance of ingredients, ensuring efficacy and sustainability.
2. Physical Property Evaluation: Physical properties, such as pH, relative density, odour, and dispersion in water, should be evaluated to ensure the suitability of the disinfectant product for various applications.

3. Further Research: Further research should be conducted to explore the efficacy of the disinfectant against various microorganisms and in different settings, including healthcare and industrial environments.
4. Environmental Impact Assessment: The environmental impact of disinfectant products should be assessed to ensure their sustainability and eco-friendliness.
5. Regulatory Compliance: Manufacturers should ensure that their disinfectant products comply with relevant regulatory standards and guidelines.
6. Quality Control: Quality control measures should be implemented to ensure the consistency and reliability of disinfectant products.
7. Product Labeling: Product labels should provide clear instructions for use, including recommended dilution ratios and safety precautions

REFERENCES

1. Jahn, L., & Bhattacharyya, N. (2023). Influence of application method on disinfectant byproduct formation during indoor bleach cleaning: A case study on phenol chlorination. ACS ES&T Air.
2. (2025). Agricultural biowaste based disinfectant formulation mitigates drug resistant nosocomial pathogens. Microbial Pathogenesis.
3. Prasse, C., von Gunten, U., & Sedlak, D. L. (2020). Chlorination of phenols revisited: Unexpected formation of α,β-unsaturated C 4-dicarbonyl ring cleavage products. Environmental Science & Technology.
4. Patil, A. H., Mishra, R. M., & Kundar, R. (2023). Study of phenol degrading bacterium isolated from a petrochemical contaminated site.
5. Lakhe, S., & Khadse, S. T. (2020). Comparison of disinfectant by phenol coefficient method. World Journal of Pharmaceutical Research.
6. Sumathy, V. J. H. (2016). Antimicrobial activity of disinfectants and comparative study with phenol. International Journal of Current Trends in Pharmaceutical Research.
7. Adetitun, D. O. (2023). Bacterial degradation of phenol: A review of the current state of knowledge.
8. Chuang, Y.-H., McCurry, D. L., Tung, H.-H., & Mitch, W. A. (2015). Formation pathways and tradeoffs between haloacetamides and haloacetaldehydes during combined chlorination and chloramination of lignin phenols and natural waters. Environmental Science & Technology.
9. Li, J., Wang, W., Moe, B., & Li, X.-F. (2015). Chemical and toxicological characterization of halobenzoquinones, an emerging class of disinfection byproducts. Chemical Research in Toxicology.
10. Wen, Y., Li, C., Song, X., & Yang, Y. (2020). Biodegradation of phenol by Rhodococcus sp. strain SKC: Characterization and kinetics study. Molecules.
11. Sachan, P., Madan, S., & Hussain, A. (2019). Isolation and screening of phenol-degrading bacteria from pulp and paper mill effluent.
12. Asiagwu, A., & Peretemo-Clark, B. Production of phenol-based disinfectant, using vegetable oil soda as surfactant. International Journal of Natural and Applied Sciences.