

Design and Fabrication of Fruit Sanitization Machine

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Abstract: *This study documented the current status of Fruit sanitization as an essential step in food processing to ensure the removal of microorganisms and other harmful contaminants. This research paper presents the design and fabrication of a fruit sanitization machine that utilizes ultraviolet (UV) light and ozone gas to disinfect fruits. The machine consists of a stainless steel chamber, UV lamps, and an ozone generator. The fruits are placed inside the chamber, and the UV lamps and ozone generator are activated to sanitize the fruits. The machine was tested using different types of fruits, including apples, oranges, and grapes. The results showed a significant reduction in bacterial and fungal counts, indicating the effectiveness of the machine in fruit sanitization.*

Keywords: UV light, Mist Sprayer

I. INTRODUCTION

Fruits are an essential component of a healthy diet and are consumed in large quantities worldwide. However, they are susceptible to contamination by microorganisms and other harmful contaminants during harvesting, transportation, and storage. To ensure the safety of consumers, it is necessary to sanitize fruits before consumption. Traditional methods of fruit sanitization, such as washing with water and detergent, have limitations in their effectiveness in removing microorganisms. Therefore, there is a need for a more effective method of fruit sanitization.

Ultraviolet (UV) light and ozone gas have been identified as effective methods of disinfection. , UV light can destroy microorganisms by disrupting their DNA, while ozone gas can destroy microorganisms by oxidizing their cell walls. In this research paper, we present the design and fabrication of a fruit sanitization machine that utilizes both UV light and ozone gas to disinfect fruits.

II. EXISTING SYSTEM

There are several existing systems for fruit and vegetable sanitization that have been studied in research papers.

- Ultrasonic cleaning machine: This equipment has been researched for cleaning fruits and vegetables, and according to the nature of agricultural products, the appropriate ultrasonic cleaning.
- Ozone Technology: Research focuses on the effects of gaseous ozone and ozone water treatment on microbial growth to improve the safety and quality of fresh fruits and vegetables.
- Washing and cleaning process: Instructions for packaging fresh or small fruit and vegetables often specify washing or cleaning steps to remove dirt, pesticides, and other contaminants. Patient.
- Disinfectants: Cleaning of containers, cleaning fluids, brushes, belts, sorters, and other work equipment is important when working with fruit and vegetables
- Cleaning water: This process is recommended as an effective disinfectant for cleaning water in the vegetable industry.
- Development of washing and cleaning products: Scientists are experimenting with commercial cleaning products and disinfectants to minimize the number of diseases in fresh fruits and vegetables.

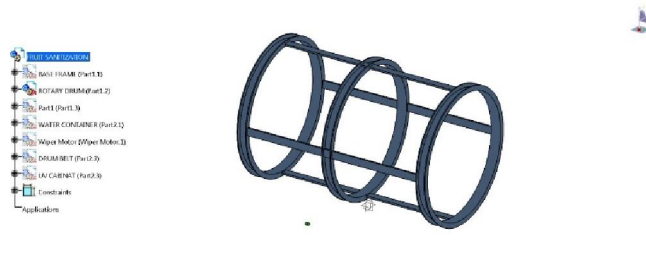
III. PROPOSED SYSTEM

- Multi-stage sanitization process: The proposed system incorporates a multi-stage sanitization process to ensure thorough and effective sanitization of fruits. This process may include stages such as pre-washing, brushing, high-pressure washing, immersion in sanitizing agents, and final rinsing. Each stage is designed to target specific contaminants and optimize sanitization results. Ultrasonic technology: Ultrasonic technology can be used to remove dirt, dust, grime, and agricultural chemicals from fruits and vegetables effectively and easily
- Energy efficiency and sustainability: The proposed system considers energy efficiency and sustainability principles in its design. Energy-saving components, such as efficient motors and pumps, are incorporated. The system may also explore the use of renewable energy sources or energy recovery systems to minimize environmental impact and reduce operating costs.
- Multifunctional: The machine should be multifunctional and able to clean different types of produce, including fruits, vegetables, and leafy greens.
- Easy to use: The machine should be easy to operate, with simple controls that are easy to understand.
- Overall, a fruit and vegetable sanitization machine should be designed to clean produce thoroughly, remove harmful microorganisms, and make it safe for consumption. It should also be easy to use, and multifunctional.
- Compact and modular design: The proposed system features a compact and modular design, allowing for scalability and easy integration into existing fruit processing lines or facilities.

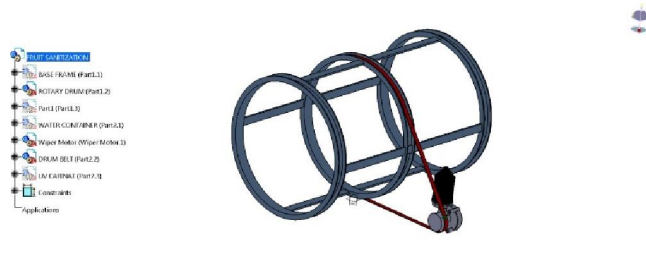
IV. OPERATION

Base frame acts as the main frame of the body structure of the mechanical structure. It is one of the most important parts to be considered when designing a mechanical structure. Base frame is defined as the lower part of a mechanical structure which includes the wheels, frame, driveline, engine and suspensions. There are three types of base frame structure which is the ladder base frame, space frame base frame and monologue base frame.

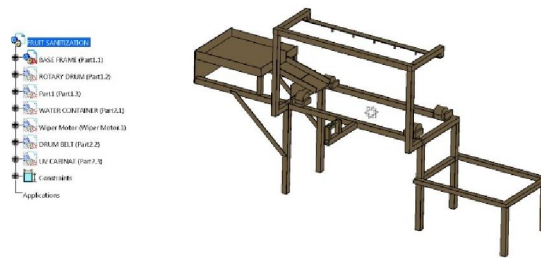
1. Barrel: The barrel is fabricated with a 2 mm perforated sword distance. The Barrel periphery is 400 mm and the Length is 600 mm. The drum is supported at both ends with breakers and opens at both sides. MS flat 25x3mm is framed from the outside to form a barrel shape.



2. Drive Mechanism: Barrel is powered by a 100-watt electric motor driven by a belt drive mechanism as shown.

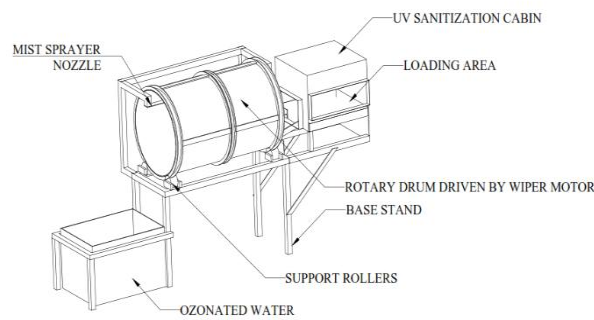
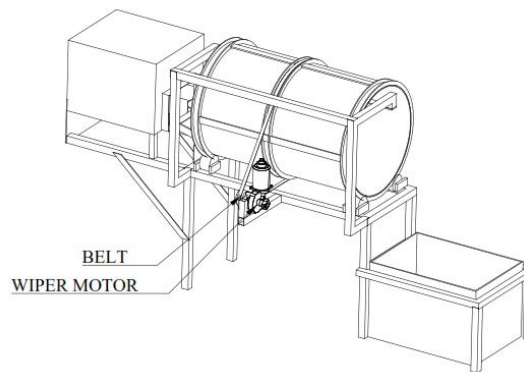
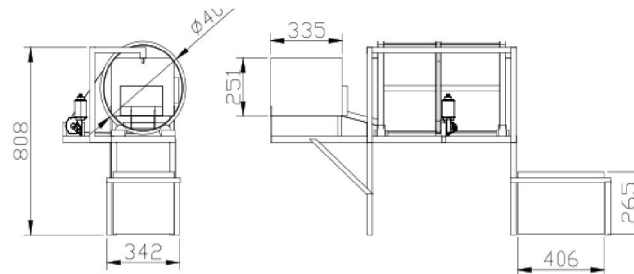


3. Stand Structure:

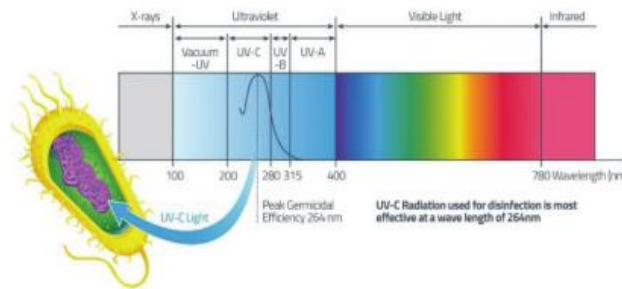


Supporting frame fabricated with Steel angle section 30x30x3mm. Which supports the complete setup including water tanks at bottom. A supporting provision is provided with frame for barrel open end to avoid vegetables fell out of the barrel during cleaning. Height of setup is 1524mm.

Drafting done using AutoCAD Software:



UV LIGHT: UV light is connected to a separate power supply via a relay and switched on by an electronic trigger generated from Arduino. Here UVC lights are being used as it is effective for destroying pathogens and other bacteria, virus present in air, and moisture. From relays, UVC lights are connected and when a trigger from Arduino is given, a switch is closed in the relay and UV lights are ON



V. OBJECTIVE

It is anticipated that the design and fabrication of the fruit sanitization machine will contribute to the development of advanced and efficient systems for ensuring the safety and quality of fruits.

1. To Develop a UV cabinet.
2. To make a Mist sprayer inside the rotary drum.
3. To Utilize ozonated water for sanitization.
4. To Testing of the complete project.

The fruit sanitization machine aims to improve food safety by reducing the risk of foodborne illnesses associated with consuming contaminated fruits.

VI. ADVANTAGES

- Consistent sanitization: Fruit sanitization machines provide a standardized and consistent sanitization process. Unlike manual sanitization methods, which can vary in effectiveness depending on individual practices, machines offer a uniform and controlled sanitization process. This leads to more reliable and predictable results, ensuring that all fruits undergo the same level of sanitization.
- Preservation of fruit quality: Fruit sanitization machines are designed to effectively remove contaminants while minimizing any negative impact on fruit quality attributes such as taste, texture, and nutritional value. By utilizing appropriate sanitization methods and optimizing sanitization parameters, these machines can preserve the quality of fruits, ensuring that they maintain their freshness and sensory characteristics.
- Cost-effectiveness: Fruit sanitization machines can offer long-term cost savings for fruit producers and processors. Although there is an initial investment in designing and fabricating the machine, automation and increased efficiency lead to reduced labor costs and improved productivity. Moreover, the prevention of foodborne illnesses and the avoidance of potential product recalls or legal liabilities contribute to cost savings and protect brand reputation.
- Enhanced food safety: Fruit sanitization machines effectively remove contaminants and pathogens from the surface of fruits, significantly reducing the risk of foodborne illnesses. By eliminating microbial contaminants, pesticide residues, and handling-related pollutants, these machines ensure that fruits are safe for consumption, protecting consumer health.

VII. DISADVANTAGES

- Initial cost and investment: Designing and fabricating fruit sanitization machines can involve a significant initial cost, especially for customized or technologically advanced systems. The expenses associated with research, development, equipment, and production can be substantial, which may pose a financial barrier for smaller fruit producers or processors.

- Maintenance and operational requirements: Fruit sanitization machines require regular maintenance and calibration to ensure optimal performance. This includes cleaning, replacing components, and conducting routine inspections. Neglecting maintenance can lead to reduced sanitization efficacy and potential breakdowns, which may incur additional costs and downtime for repairs.
- Potential impact on fruit quality: While efforts are made to minimize the impact on fruit quality, certain sanitization methods or operating parameters can still affect the sensory attributes of fruits. For example, excessive exposure to sanitizing agents or rough handling during the sanitization process can lead to texture changes, flavor alterations, or the degradation of nutritional components. Balancing sanitization efficacy with preserving fruit quality is a crucial consideration.

VIII. APPLICATIONS

- Fruit processing and packaging facilities: Fruit sanitization machines are commonly used in fruit processing and packaging facilities. These machines ensure that the fruits are thoroughly cleaned and sanitized before they undergo further processing, such as sorting, grading, and packaging. By removing contaminants and pathogens, the machines help maintain the quality and safety of the fruits throughout the processing and packaging stages.
- Agricultural farms and orchards: Fruit sanitization machines can be employed directly in agricultural farms and orchards to sanitize fruits before harvest or post-harvest. This helps ensure that the fruits are free from microbial contaminants, pesticides, and other pollutants that might have accumulated during cultivation. By implementing sanitization at the source, the machines contribute to maintaining the quality and safety of the fruits from the early stages of production.
- Fruit retail and distribution centers: Fruit sanitization machines can be utilized in retail and distribution centers to ensure that the fruits reaching consumers are clean and safe. By removing dirt, debris, pesticides, and microbial contaminants, the machines contribute to maintaining the quality and hygiene of the fruits during storage and distribution, reducing the risk of foodborne illnesses.
- Fruit export and import: The export and import of fruits often involve stringent regulations and quality standards. Fruit sanitization machines play a crucial role in meeting these requirements by effectively sanitizing the fruits and ensuring compliance with international food safety regulations. These machines help prevent the spread of pests, diseases, and contaminants across borders, facilitating safe and smooth trade.

IX. FUTURE SCOPE

- Sustainable and eco-friendly design: Future research could focus on designing fruit sanitization machines with a strong emphasis on sustainability and environmental impact. This includes exploring eco-friendly sanitization agents, energy-efficient systems, and the use of recyclable materials to reduce the ecological footprint of the machines.
- Simplicity is the ultimate sophistication: Designing the most cost-effective mechanism, eliminating the complexity as the saying goes.
- Commercial scalability: While the research paper may focus on the design and fabrication of a fruit sanitization machine, future studies could investigate the scalability of the machine for commercial production. This includes addressing manufacturing challenges, optimizing production processes, and conducting cost-benefit analyses to assess the viability of large-scale deployment.
- Advanced sanitization techniques: While current sanitization methods are effective, there is ongoing research into novel sanitization techniques. Future studies could explore the integration of emerging technologies such as plasma-based sanitization, ozone treatment, pulsed light, or advanced non-thermal methods to further enhance the sanitization efficacy while minimizing any potential negative effects on fruit quality.

X. CONCLUSION

In conclusion, the design and fabrication of a fruit sanitization machine that utilizes UV light and ozone gas to disinfect fruits have been presented. The machine was tested using different types of fruits and showed a significant reduction in bacterial and fungal counts. This method of fruit sanitization has the potential to be used in the food industry to ensure the safety of consumers.

XI. REFERENCE

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