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Effective Onion Storage Method for Long-Term Preservation

Abhishek Jadhav[1], Sairaj Gujare[1], Aniket Dubal[1], Ravi Yallatikar[1], Sandip Wangikar[2]

[1]UG Student, Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur, Punyashlok Ahilyadevi Holkar, Solapur University, Solapur413304, Maharashtra, India

[2]Professor, Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur, Punyashlok Ahilyadevi Holkar, Solapur University, Solapur413304, Maharashtra, India

ABSTRACT

India's agriculture sector plays a vital role, contributing significantly to the GDP and employing a large portion of the population. However, farmers face challenges in preserving crops like onions due to infrastructure and technological limitations. In response, our project focuses on revolutionizing onion storage using innovative technology.

Through in-depth research, we identified separate storage systems as ideal for maintaining onion quality. Using CATIA software, we developed a 30 kg capacity model with three trays and a sturdy frame. What sets our design apart is the integration of a motor powered by a battery charged by a solar panel, enabling automated tray movement via a crank slider mechanism.

Our thorough performance analysis compared our storage unit to traditional methods, showing lower onion temperatures, minimal weight loss, and superior overall quality. These results highlight the societal impact of our project, addressing a critical agricultural issue with advanced technology. By merging innovation and practicality, we aim not only to improve onion storage but also to empower farmers and propel India's agricultural sector forward.

I. INTRODUCTION

Onions (Allium cepa L.) are a globally popular and commercially significant vegetable consumed in various forms. In Iraq, onions rank among the top five cultivated vegetable crops. Worldwide, onion production reaches an estimated 105 billion pounds annually, with an average annual consumption of approximately 13.67 pounds per person. India, the second largest onion-growing country globally, is renowned for its pungent onions, available year-round through two crop cycles.

India's major onion-producing states include Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana, and Telangana, with Maharashtra leading at 39% production in 2020-21. Despite being a key player in the onion market, inadequate storage facilities have led to distress sales by farmers, resulting in price volatility.

To address this issue, the Government of India (GOI) initiated a capital subsidy program to develop proper onion storage structures at both the farm and marketplace levels, aiming to create a storage capacity of 4.5 lakh

tonnes of onions during 1999-2000 and 2000-2001, with subsidies channeled through NABARD for the credit delivery system.

To enhance the efficiency of onion storage and preservation, our project aims to make these structures fully automatic. The trays within the storage unit will be oscillated using a piston and crankshaft mechanism, powered by a motor, battery, and a solar panel for sustainable energy. This technological enhancement will not only benefit farmers but also contribute to addressing onion storage challenges in India.

II. METHODOLOGY

1. Onion storage unit

Fig.1.Storage Unit

The onion storage device comprises three trays, each accommodating 10kg of onions, with an oscillation feature for optimal ventilation. This design prevents moisture accumulation, extending shelf life. Its efficient airflow layout suits India's onion-focused agriculture, reducing post-harvest losses. This innovation aids farmers and supply chains, enhancing efficiency and sustainability in onion storage and distribution, crucial for agricultural economies like India's.

2. Motor

The MY1016Z motor is widely respected in mechanical engineering circles for its compact yet powerful design. As part of the MY1016 series, it has earned a reputation for reliability and efficiency, making it a popular choice in DIY projects, robotics, and small-scale automation applications. Operating on DC power, this motor delivers a significant amount of torque relative to its size, making it ideal for tasks that require moderate power output and precise control.

In our onion storage device, the MY1016Z motor plays a critical role in driving the oscillation mechanism for the trays. This mechanism, based on a crank-slider design, converts the motor's rotary motion into linear oscillatory motion. This oscillation is essential for ensuring proper ventilation and airflow around the onions, contributing significantly to their preservation and extending their shelf life.

What makes the MY1016Z motor particularly suitable for this application is its torque output and compatibility with DC power sources. These characteristics enable it to provide the necessary power and control for the oscillating trays while maintaining energy efficiency. Additionally, its compact size allows for seamless integration into the device without compromising space or functionality.

The reliability and durability of the MY1016Z motor are also noteworthy, ensuring consistent performance over extended periods. This reliability is crucial in agricultural settings where continuous operation and minimal maintenance are paramount. Overall, the MY1016Z motor exemplifies the synergy of compact design, robust performance, and versatility, making it an excellent choice for driving the oscillation mechanism in our onion storage device and contributing to its overall efficiency and effectiveness in preserving onions.

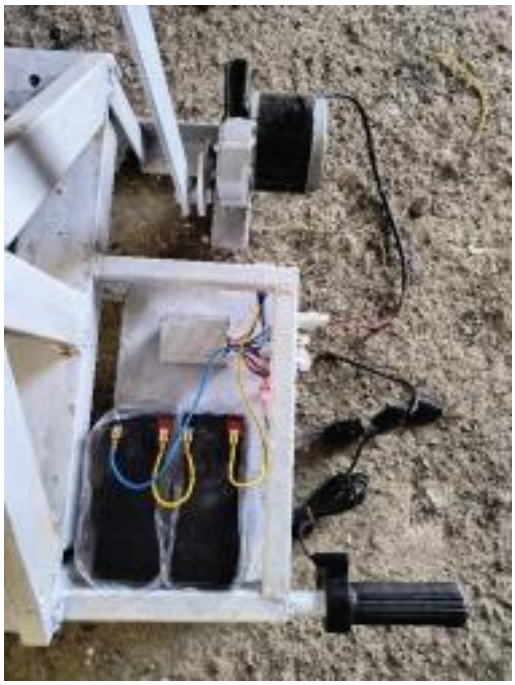

Fig.2. Motor MY1016Z

3. Battery

Fig.3. Battery 12v

The 24V battery is a crucial component in our energy storage system, designed to power the various mechanisms of our onion storage device, including the MY1016Z motor driving the oscillation mechanism.

This battery, operating at a voltage of 24 volts, offers a balance between power output and energy efficiency, making it suitable for applications requiring moderate power levels over extended periods.

In our setup, the 24V battery serves as a reliable source of energy, ensuring uninterrupted operation of the motor and other electronic components. Its capacity to store electrical energy allows us to optimize power usage and regulate the supply to the motor, enhancing overall system efficiency and performance.

One of the key advantages of the 24V battery is its compatibility with the MY1016Z motor and other electrical components, providing a seamless power supply solution. This compatibility ensures that the motor receives consistent and stable power, contributing to smooth and reliable operation.

Moreover, the 24V battery's design prioritizes safety and durability, meeting industry standards for electrical storage devices. Its robust construction and protective features make it suitable for use in agricultural environments, where reliability and resilience are essential factors.

By incorporating the 24V battery into our onion storage device, we not only ensure reliable power supply to the motor but also optimize energy usage, contributing to overall system efficiency and longevity. This strategic use of energy storage technology enhances the functionality of our device, enabling it to perform optimally in preserving onions and meeting the needs of agricultural stakeholders.

4. Solar Panel

Fig.4.Solar Panel

The solar panel is a critical component of our onion storage device, designed to harness renewable energy from sunlight and convert it into electrical power. This sustainable energy source aligns with our commitment to eco-friendly solutions and reduces dependency on traditional power sources.

The solar panel's functionality revolves around photovoltaic cells, which absorb sunlight and generate direct current (DC) electricity. This electricity is then stored in the 24V battery, serving as a reliable power source for the device's operations, including powering the MY1016Z motor that drives the oscillation mechanism for the trays.

One of the key advantages of using a solar panel is its ability to provide a continuous and clean energy supply. By utilizing sunlight, we reduce our carbon footprint and contribute to environmental sustainability. This aspect is particularly crucial in agricultural settings, where minimizing environmental impact is a priority.

The solar panel's design incorporates high-quality materials and efficient photovoltaic technology, ensuring optimal energy conversion rates and durability. Its robust construction allows it to withstand various weather conditions, making it suitable for outdoor applications such as our onion storage device.

Moreover, the integration of a solar panel enhances the device's versatility and reduces operating costs by utilizing free and abundant solar energy. This strategic use of renewable energy not only benefits the environment but also improves the economic feasibility of our storage solution, making it attractive to farmers and agricultural stakeholders.

Overall, the inclusion of a solar panel in our onion storage device represents a forward-thinking approach to energy management, promoting sustainability and efficiency in agricultural practices.

III.RESULTS AND DISCUSSION

1. Modified Storage Unit:

Fig. 5 Modified Storage Unit

The onion storage device integrates a sophisticated mechanism designed to enhance efficiency and sustainability. This mechanism consists of three primary components: a motor, a battery, and a solar panel, each playing a crucial role in its operation.

Firstly, the motor is the driving force behind the device's functionality. It powers the oscillation of the trays, which are designed to hold up to 30 kilograms of onions across three levels. The oscillatory motion ensures proper ventilation, preventing moisture accumulation and promoting air circulation. This consistent movement maintains the onions' freshness and extends their shelf life by reducing the risk of spoilage.

Secondly, the battery serves as the device's energy reservoir. It stores electrical energy generated by the solar panel, ensuring a continuous power supply. During the day, the battery is charged by the solar panel, and it

provides power to the motor during periods of low sunlight or nighttime. This ensures uninterrupted operation, maintaining the oscillatory motion of the trays regardless of external conditions.

Thirdly, the solar panel is a key component that underscores the device's commitment to sustainability. By harnessing solar energy, the panel converts sunlight into electrical power, which is then stored in the battery. This not only reduces reliance on traditional energy sources but also lowers operational costs and minimizes the environmental impact. The integration of solar technology makes the device self-sufficient and eco-friendly, aligning with modern energy efficiency standards.

Together, these components create a seamless and efficient mechanism. The motor ensures effective ventilation, the battery guarantees a reliable power supply, and the solar panel provides a sustainable energy source. This innovative approach not only enhances the storage capabilities of onions but also represents a forward-thinking solution in agricultural technology. The device exemplifies the fusion of traditional agricultural practices with cutting-edge engineering, contributing to improved food preservation and sustainability.

2. Movement of Trays by using Motor:

Fig. 6 Position 1

The trays oscillate between different positions, with the motor playing a crucial role in this movement. In the first position, the trays remain stationary, aligned in a straight line parallel to the ground. This alignment ensures stability and facilitates even airflow around the stored onions. By maintaining this position, the trays effectively contribute to optimal ventilation and prevent any potential blockage of air circulation, thereby enhancing storage conditions and extending the onions' shelf life.

Fig. 7 Position 2

In the second position, once the motor is activated, the trays oscillate and tilt, becoming inclined relative to the ground. This inclination enhances airflow and promotes efficient ventilation around the stored onions. The motor's crucial role in initiating and maintaining this oscillation ensures that the trays alternate between their stationary and inclined positions, optimizing the storage environment. This dynamic movement helps prevent moisture buildup and extends the shelf life of the onions.

Fig. 8 Position 3

In the third position, the trays tilt to the opposite side. This further enhances the oscillation mechanism, ensuring comprehensive airflow and ventilation around the stored onions. By alternating between different inclinations, the motor-driven trays prevent moisture accumulation and promote uniform drying. This dynamic movement is crucial for maintaining optimal storage conditions and extending the shelf life of the onions, demonstrating the importance of the motor in facilitating effective ventilation and preservation.

3. Temperature Reading of the Onion

Days	Enhanced Temp.	Previous temp.
1	27	27
2	27.1	27.1
3	26.85	26.9
4	26.8	26.8
5	26.7	26.9
6	26.75	26.7
7	26.2	26.3
8	26	26.1
9	25.5	25.7
10	25.6	25.9
11	25.7	26.1
12	25.6	26.4
13	25.8	26
14	25.9	26.2
15	25.85	26.4
16	25.9	26.4
17	25.95	26.5
18	26	26.3
19	25.9	26.9
20	25.6	26.4

Table 1. Temp. Reading of onion

The Enhanced temperature represents temperature for the onions stored in the Automated storage unit while the Previous temperature represents the temperature of onions stored by Previous Fabricated Storage Unit way.

4. Weight Calculation of the Onion:

No. of days	Enhanced Weight Pervious Weight	
1	30	30
4	29.95	29.95
8	29.93	29.9
12	29.91	29.88
16	29.87	29.85
20	29.85	29.83

Table 2. Weight calculation of the Onion

The Weight calculation of the onion is presented above in Table 2. The Enhanced weight represents weight for the onions stored in the Automated storage unit while the Previous weight represents the weights of onions stored by Previous Fabricated storage unit way.

IV. CONCLUSION AND FUTURE SOPE

In conclusion, our onion storage project embodies innovation and sustainability in agricultural technology. By incorporating a solar panel for renewable energy and utilizing a 24V battery for efficient power storage, we ensure reliable operation while minimizing environmental impact. The integration of the MY1016Z motor with a crank-slider mechanism enables gentle oscillation for proper ventilation, crucial in preserving onion quality. This combination of technological advancements not only enhances storage efficiency but also contributes to reducing post-harvest losses, benefiting farmers and supply chains.

Looking ahead, our vision includes further automation of the onion storage system. We plan to integrate a WiFi module and various sensors, enabling remote monitoring and control through a mobile application. This future upgrade will enhance user convenience and system efficiency, allowing farmers to manage their onion storage remotely and optimize conditions based on real-time data. The inclusion of sensors will enable automated adjustments in ventilation, temperature, and humidity, ensuring optimal storage conditions and extending the shelf life of onions. By embracing these advancements, we aim to revolutionize onion storage practices, promoting sustainability, and empowering farmers with advanced, user- friendly technology tailored to their needs.

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