DESIGN AND DEVELOPMENT OF A VACUUM-ASSISTED MULTI-CROP DRYER UTILIZING LIQUID CONVECTION AND RADIATION FOR ENHANCED PRODUCT QUALITY

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Keywords:

1. Vacuum-Assisted Continuous Drying

2. Multi-Crop Rotary Dryer

3. Sustainable Drying

4. Energy-Efficient

5. Radiation Heating

Introduction/Background:

This project designs a vacuum-assisted multi-crop dryer that integrates electrical and biomass heating for efficient and sustainable moisture removal. The system utilizes a vacuum environment to facilitate moisture extraction at lower temperatures, preserving crop quality.

Key features include:

1. Rotary drum mechanism for uniform heat distribution

2. Sensor control unit for precise temperature, pressure, and moisture regulation

3. Sustainable energy sources like electrical or biomass heating

Objectives:

1. Design and develop a vacuum-assisted multi-crop dryer that integrates electrical and biomass heating.

2. Improve crop quality and reduce drying time by utilizing a vacuum environment and precise temperature control.

3. Enhance energy efficiency and eco-friendliness by incorporating sustainable energy sources.

4. Develop an sensor control unit for precise regulation of temperature, pressure, and moisture levels.

5. Provide a versatile solution for drying various crops, reducing post-harvest losses and increasing farmer income.

6. Evaluate the system's performance and compare it with conventional dryers in terms of drying rate, energy efficiency, and product quality.

7. Optimize the system's design and operation for scalability and adaptability to different farm sizes and crop types.

Methodology:

1. Design and simulation: Utilize design software to design the vacuum-assisted multi-crop dryer.

2. Material selection: Select suitable materials for the dryer's construction, considering factors such as durability, corrosion resistance, and thermal conductivity.

3. Prototype development: Fabricate a prototype of the dryer, incorporating the designed components and systems.

4. Testing and evaluation: Conduct experiments to evaluate the dryer's performance, including drying rate, energy efficiency, and product quality.

5. Data analysis: Analyze the collected data to identify areas for improvement and optimize the system's design and operation.

Project Outcome & Industry Relevance:

Energy-efficient dryer suitable for diverse crops.

Reduction in post-harvest losses and extension of shelf life.

Eco-friendly system with renewable energy integration.

Improved crop quality with enhanced texture and nutritional value.

Affordable, low-maintenance design for farmers.

Economic benefits: increased farmer income and job creation.

Scalable design adaptable to varying farm sizes.

Contribution to agricultural best practices.

Working Model vs. Simulation/Study:

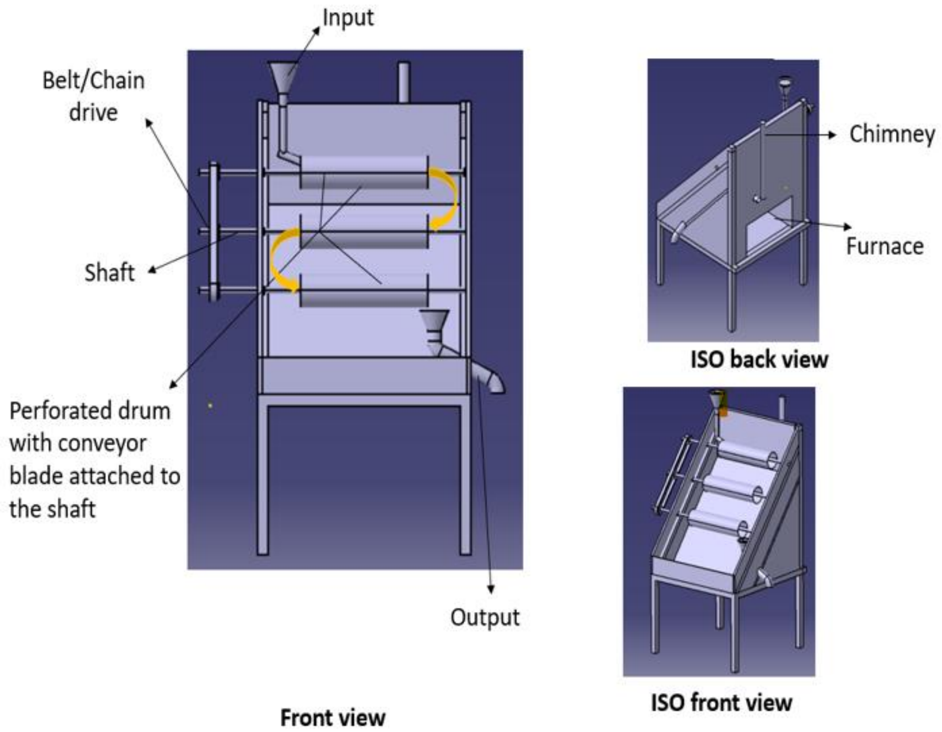

Fig 1: Conceptual design

(a) **(b)**

Fig 2: Development of Design, (a) Inside view (b) ISO front view

Future Scope:

The vacuum-assisted multi-crop dryer represents a significant advancement in agricultural technology. By integrating biomass and sustainable energy, the system offers efficient drying, quality preservation, and eco-friendly operation, benefiting farmers and contributing to sustainable practices.