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IMPROVE THE PERFORMANCE OF SOLAR DRYER WITH EVACUATED TUBE COLLECTOR USING EXHAUST OF SI ENGINE

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ABSTRACT

Nowadays, the important over energy requirement is keep on increasing which also proportionally elevating the level of pollution in the atmosphere. The climate changes due to the causes of global warming increased the probability of predicting weather roughly more than the olden days which made the governments all around the world to focus on the alternative source of energy. Based on the sources of consumption, the non-renewable energy such as petrol and diesel are the two major raw materials for the energy production process. though petrol were one of the main sources of raw material in transportation and other industrial usages the research and development department in various sector keep on concentrating waste heat recovery from the exhaust of SI engine has been soared. Today since there are several methods in drying process such as direct type, indirect type and mixed mode type which are further classified into special methods of natural convection and forced convection. In our project we used the forced convection indirect type. By extracting the atmosphere air from the blower to the heat exchanger where, it recharge the energy from the exhaust of SI engine. and the converted heat energy will be again passed into the flat plate collector, where it further rise the heat energy by adding solar energy from the sun. finally, the added heat energy will be sent to the dryer chamber where the vegetables over there will get dried by the process of removing moisture content from the products.

INTRODUCTION

The conventional drying system to preserve fruits, vegetables, grains, fish, meat, wood and other agricultural products is sun drying which is a free and renewable source of energy. But, for large-scale production, there are various known limitations of sun drying as damage to the crops by animals, birds and rodents, degradation in quality due to direct exposure to solar radiation, dew or rain, contamination by dirt, dust or debris. Also this system is labour- and time intensive, as crops have to be covered at night and during bad weather, and have to be protected from attack by domestic animals. There is also a chance of insect infestation and growth of microorganism due to non-uniform drying. The advancement of drying with the source from solar and vehicle exhaust gas in which products are dried in a closed system in which inside temperature is higher . Major advantage includes protection against flies, pests, rain or dust. Several significant attempts have been made in recent years to harness solar energy for drying mainly to preserve agricultural products and get the benefit from the energy provided by the sun. Sun drying of crops is the most widespread method of food preservation in most part of India and world because of solar irradiance being very high for the most of the year. As this technique needs no energy during day time, it is more beneficial to the small scale farmers who can't afford the electricity or other fuel for drying. If it is necessary to dry product in night or in bad weather, an additional heat from vehicle exhaust gas is used. The high temperature dryers used in commercial countries are found to be economically viable in developing countries only on large agro sectors and generally it is not affordable by small and medium entrepreneurs because of high cost and process variability. Therefore, the introduction of low cost and locally manufactured dryers provides a promising alternative to reduce the grand postharvest losses. The opportunity to produce high quality marketable products appears to be a chance to improve the economic situation of the farmers. Taking into account the low income of the rural population in developing countries, the relatively high initial investment for dryers still remains a barrier to a wide application. However, if it is manufactured by locally available material such as wood, glass etc., it will be economically affordable by the farmers.

LITERATURE SURVEY

Halleck et al developed a modified cabinet dryer. It has the shape of metal staircase with its bases and sides covered with double-walled galvanized metal sheets with cavity filled by non-degradable thermal insulation. Polycarbonate (non-breakable) was used to cover the upper surface. The dryer is divided in to three compartments with shelf to accommodate the products. The base of the dryer and partition valve have 4 holes for air circulation. Separate door is provided to access the compartments. A solar cabinet dryer was developed by R.J.Fuller. The temperature in a solar cabinet is higher than in sun drying and this reduces the drying time and usually improves the final product quality. Crop losses and spoilage from rain and animals are prevented because the crop is protected within the solar dryer. PP Singh et al designed a small size PAU domestic natural convection solar dryer. Which consists of a hot box, shading, trays and base frame (size 19mm× 19mm×1.6mm). A transparent window glass (4mm) was fixed as glazing. 40 holes with total area of 0.002m² provided on the top side of the dryer for air circulation. This system generates 55oCto 60oC heated air continuously. This dryer is suitable for drying turmeric rhizomes. EL-Amin Omda Mohamed Akoy et al developed a solar dryer for drying of mango slices . A minimum of 16.8m2 solar collector area is required to dry a batch of 100 kg sliced mango (195.2kg fresh mango at 51.22% pulp) in 20hours (two days drying period). The initial and final moisture content considered were 81.4% and 10% wet basis, respectively. The average ambient conditions are 30ºC air temperature and 15% relative humidity with daily global solar radiation incident on horizontal surface of about 20MJ/m2/day. The weather conditions considered are of Khartoum, Sudan. A prototype of the dryer is so designed and constructed that has a maximum collector area of 1.03 m2. This prototype dryer has been used in experimental drying tests under various loading conditions.

WORKING PROCEDURE

Initially the flat plate collector should be connected to the dryer end with the hose, as it is forced convection method we use blower to extract the atmospheric air which are then passed to the collector. Then the vegetables used for drying process are kept inside the dryer. Then the blower should be switched on and the atmospheric air will be heated by the flat plate collector through solar radiation hence the hot air will be passed into the dryer chamber which remove the moisture content and the weight of the product should be taken subsequently in the interval of 1&1/2 hour.

Next the exhaust air from the engine should be connected to the heat exchanger where it remove the exhaust impurities And only let allow the heat energy to transfer into the copper pipes carrying atmospheric air. Then again the heated air will be sent to the flat plate collector where it is further heated. Then the overheated air will be passed into dryer chamber and it removes the moisture content inside the vegetables faster than before by providing additional energy from the SI exhaust. Again the reading should be calculated in the interval of 1 and ½ hour as did on previous setup. Then compare the results provided and it will be clear that the drying process carried with exhaust of SI engine will have a higher efficiency.

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PHOTOCOPY OF THE PROJECT

Fig 1.23 photocopy of the project

Table 4.1: Reading after adding exhaust to the collector

ITEMS	WEIGHT(g)			
	11:00 AM	12:30 PM	2:15 PM	4:00 PM
MURRAYA KOENIGII (Curry leaves)	60	45	38	29
ARMORICIA RUSTICANA				
(Radish)	150	100	78	59
SOLANUM MELONGEN				
(Brinjal)	130	100	74	61
ALLIUM SATIVUM(Garlic)	50	30	30	25
CORIANDRUM SATIVUM(Coriander)	90	50	36	27

Table: 4.2 Reading only with flat plate collector

ITEMS	WEIGHT(g)			
	11:00 AM	12:30 PM	2:15 PM	4:00 PM
MURRAYA KOENIGII (Curry leaves)	60	50	40	30
ARMORICIA RUSTICANA (Radish)	170	120	90	70

SOLANUM MELONGENA (Brinjal)	150	110	80	60
ALLIUM SATIVUM(Garlic)	100	70	60	50
CORIANDRUM SATIVUM (Coriander)	100	60	40	30

GRAPHICAL REPRESENTATION

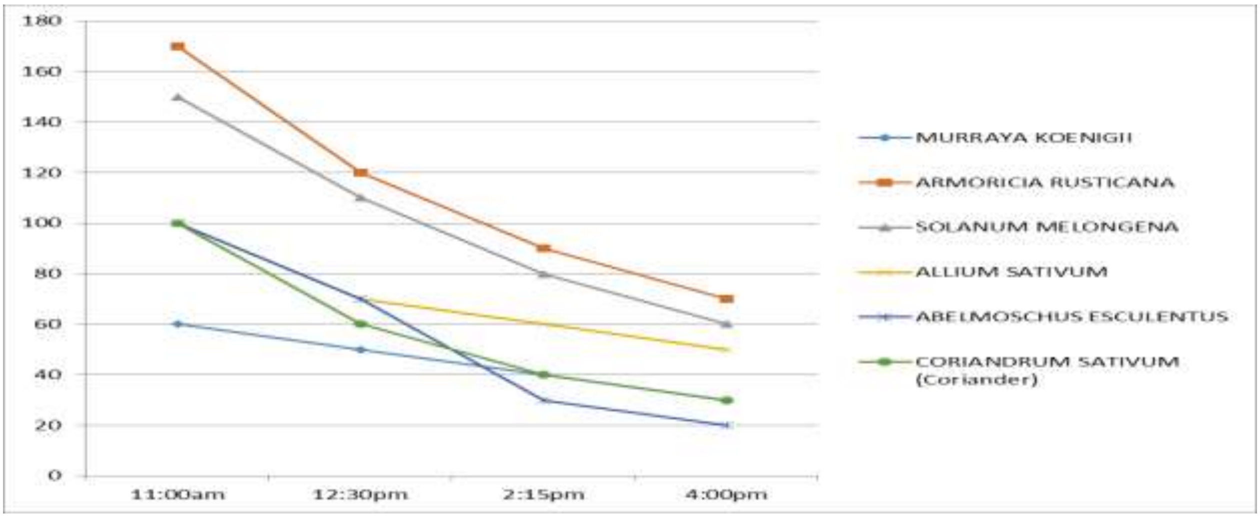

Fig: 1.24 Graphical representation of moisture content eliminated only using flat plate collector

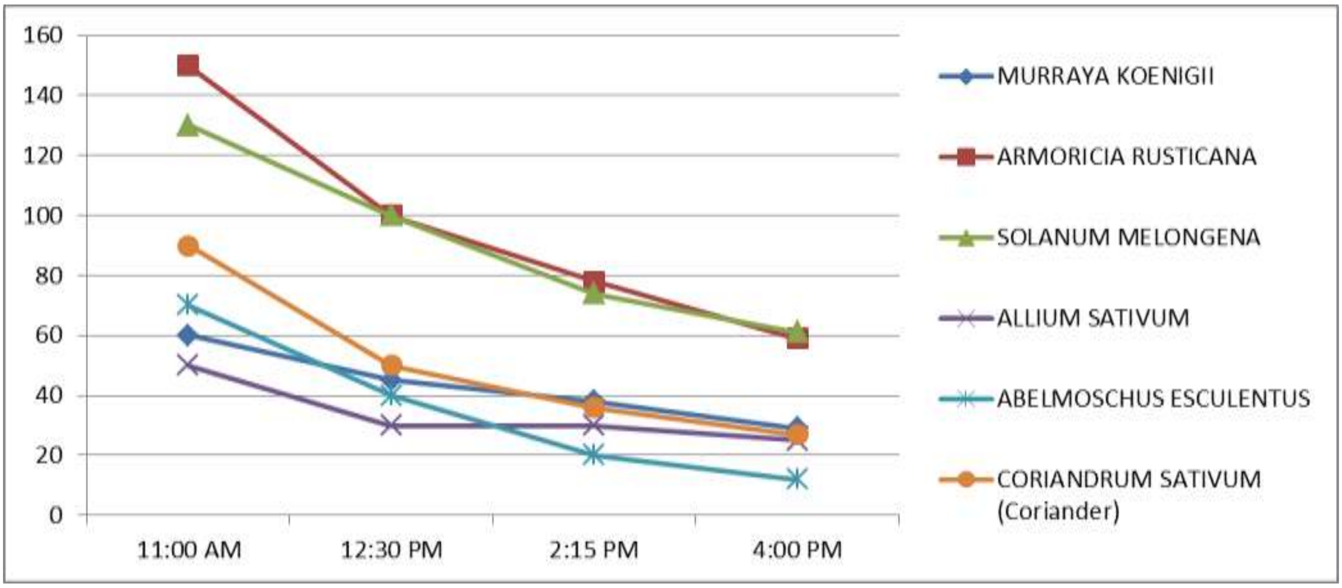

Fig 1.25 Graphical representation of moisture content after adding SI exhaust to the flat plate collector

CONCLUSION

From the test carried out, the following conclusions were made. The solar dryer can raise the ambient air temperature to a considerable high value for increasing the drying rate of agricultural crops. The product inside the dryer requires less attentions, like attack of the product by rain or pest (both human and animals), compared with those in the open sun drying. Although the dryer was used to dry other crops like yams, cassava, maize and plantain etc. There is ease in monitoring when compared to the natural sun drying technique. The capital cost involved in the construction of a solar dryer is much lower to that of a mechanical dryer.

Also from the test carried out, the simple and inexpensive mixed-mode solar dryer was designed and constructed using locally sourced materials. The hourly variation of the temperatures inside the cabinet and air-heater are much higher than the ambient temperature during the most hours of the day-light. The dryer exhibited sufficient ability to dry food items reasonably rapidly to a safe moisture level and simultaneously it ensures a superior quality of the dried product. Hence the dryer provided with SI Exhaust has the efficiency of 25% higher than the efficiency of dryer only with the flat plate collector

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