Numerical Analysis of All Type Seed Drier Using Analysis Software

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Abstract - *The All Type seed drier is a specially designed drier which is used for improving the drying techniques. Apart from the conventional drier, the All Type Seed Drier ensures uniform heating and maintaining the quality of dried seeds, and avoiding the overheating and spoilage of seeds. To determine the overall performance improvement, the temperature contours , heat transfer coefficients different nodal points, and the velocity of heat for a desired speed of air are obtained analytically with the help of analysis software. Comparatively the all type seed drier has high efficiency and low heat losses, and more persisting with better quality seeds. As a result storage facility of seeds can be done efficiently and effectively, moreover increasing the market value of products because drying is one important factor to be considered while deciding the quality and market value can be improved.*

1. INTRODUCTION

The existing type of seed driers does not provide uniform heat distribution and maintaining seed quality. To overcome these problems, the all type seed drier is employed. The improvement procedure is presented in analytical format. The analysis of both theses drier helps in comparing heat transfer coefficients, overall performance characteristics, and time consumed for the drying process. The introduction of net shaped duct in the drying chamber helps in distributing the hot flue gases throughout the drying chamber evenly which was a major challenge faced in traditional driers.

1.1 Theory of Grain Drying

When food grains containing a certain amount of moisture are exposed to air, moisture moves from the grain to the air, or vice versa, until there is a balance between the moisture in the grain and in the air. Each food grain has a characteristic equilibrium curve obtained by plotting a graph of moisture content against the relative humidity and temperature of the air. Moreover the drying characteristics of each crops are also different. They had to be dries in such a way that the moisture content has to be removed completely. So the spoilage and quality can be ensured. Moisture content in the grains are directly proportional to the amount of water content. There are also different types of techniques used for drying process such as physical drying, natural drying and traditional sun drying. Forced grain drying is also occasionally used for drying huge quantities of crops, by forcing large amount of air into the drying chamber. But in the traditional drying process the drying time cannot be forecasted as it depend on the weather and climatic conditions. The actions of pests and other flies severely affect natural drying process. The labour charges for drying are also a factor to be considered while deciding the overall profit.

1.2 Elimination of Moisture

A seed is in equilibrium with the environment when the rate of moisture loss from the seed to the surrounding atmosphere is equal to the rate of moisture gained by the seed from the atmosphere. Durable crops (such as grains and legumes) contain relatively low amounts of water, and perishable crops (such as fruits and vegetables) contain high amounts of water during harvesting. Therefore, durable crops can be stored for extensive periods of time in comparison to perishable crops. However, durable crops need to be dried with sufficiently low moisture content before sending to stores for safe, long-term storage. Drying is an important operation in terms of improving and extending the shelf life of durable crops. The process of elimination of moisture from the seed is called drying. Seed drying should reduce the seed moisture content to safe moisture limits to maintain its viability during storage, which may otherwise deteriorate quickly owing to affect growth. Seed drying also permits early harvesting, long term storage of seeds, more efficient use of land and manpower, the use of plant stalks as green fodder and production of high quality seeds. Drying is the most critical operation after harvesting a rice crop

2.TYPES OF DRIERS

There are different types of driers used for drying process and varies according to the mode of application. Sun Drying is the most primitive and popular methods used for drying surplus quantity of seeds. Although the machine are also used to reduce the drying time. Moisture content to 10-

12%. Direct sunlight also can adversely affect seed germinability owing to high temperature and ultraviolet radiation, especially if the moisture content of the seed is high. Moreover the sun drying is limited to adverse weather and climatic conditions, during rainy and winter seasons the sun drying methods cannot be considered as an efficient method. Artificial driers such as forced air circulation driers, electric driers, oven driers are used for eliminating the moisture content.

Table -1: Moisture content at different periods

Purpose	Required MC for safe storage	Potential problems
Weeks to a few months storage	14 % or less	Molds, discoloration, respiration loss, insect damage, moisture adsorption
8 to 12 months storage	13 % or less	Insect damage
Farmer's seeds	12% or less	Loss of Germination
Storage for more than 1 year	9 % or less	Loss of germination

Most of the driers simply focus only on the drying characteristics and does not improve the quality of dried products, moreover results in deterioration of commodities due to non uniform heating and overheating. As the temperature upto which a particular product must be dried depends on the overall quality, and ultimately the market value. Improper drying can result in fungal attacks.

2. PROPOSED MODEL OF ALL TYPE SEED DRIER

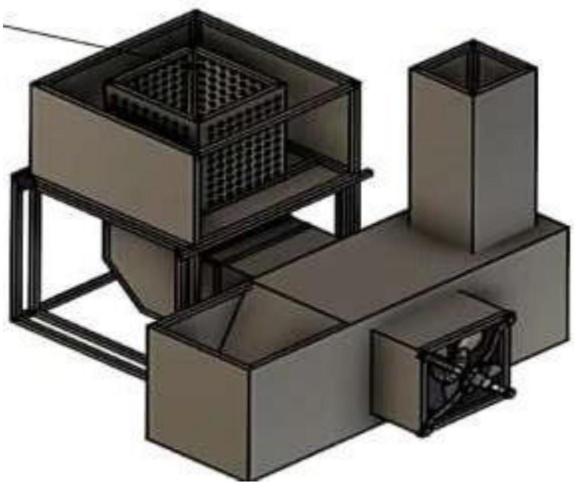

Fig-1: All type seed drier

The above shown diagram represents the all type seed drier, consisting of duct shaped duct placed inside the drying chamber with holes provided on all the direction, ensuring smooth passage of hot gases via the drying chamber. As the seeds placed inside the chamber, they will be uniformly heated since as the heat is delivered through the holes in the middle section of the duct, by adopting this method of drying the losses associated with the drying in conventional machines can be cleared. Especially the amount of fuel, time consumed, labour cost can be efficiently reduced. This type of machines could be afforded by the small and middle scale farmer's as it satisfies the needs effectively and reliably

3.1 Methodology of drier

The calculations of the new model were based on the improving the overall performance characteristics, moreover minimizing and overcoming the limitations of the existing models. The existing models used more complicated designs, and moreover the traditional driers are also large in size which causes the difficulties in housing these driers. The overall maintenance and capital cost for these driers was also an issue for the small and middle class farmers. The proposed design is effective in drying the commodities by reducing the time consumption. Unlike the existing models , the air is not heated by feeding directly into the firing chamber, here the heat is transmitted to the air with the help of a finned wall for increasing the heat transfer rate ,filtering the ashes and other dust particles which may hinders the drying process. Moreover the heat is transmitted to drying chamber. The usage of intake and exhaust fan provide efficient pathway for entry and expelling of hot gases.

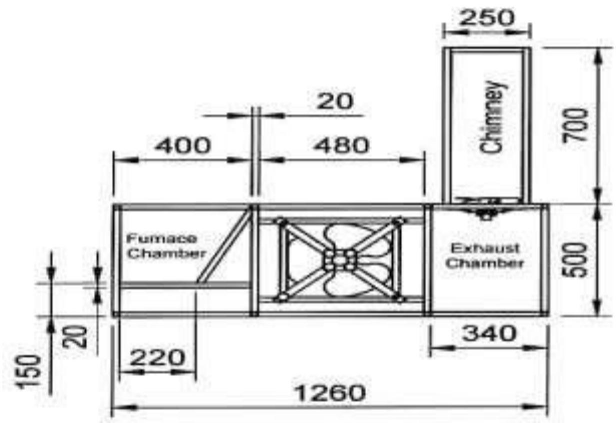

Fig -2: Design of structure

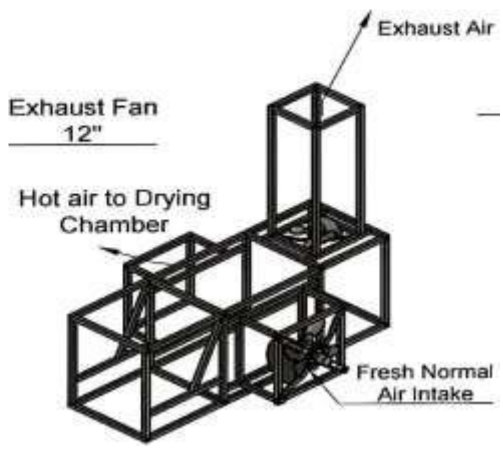

Fig-3: Isometric view of drier

3. ANALYSIS OF DRIERS USING ANSYS SOFTWARE

The Ansys software is used for determining the temperature contours, heat transfer rate and velocity with which heat is flowing through both the seed driers. The temperature variations found in the existing model on various parts of the existing driers differs by a large value, while conducting an analysis on the proposed model of drier, the variations in temperature distributions at various parts of the model approximately similar among each other. So that the amount of heat lost can be minimized in this type of model.

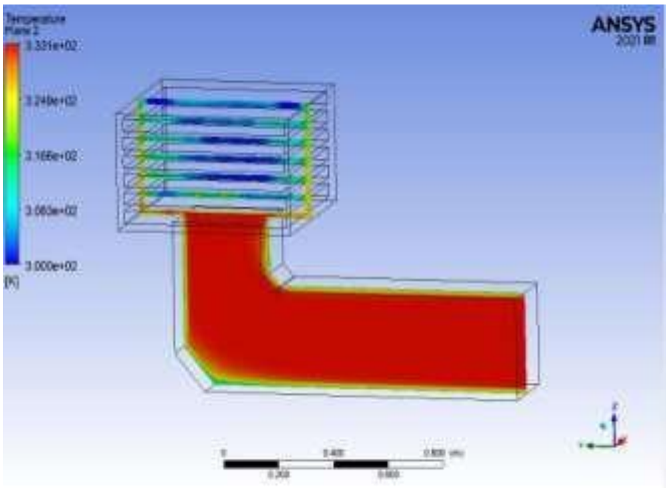

Fig -4: Temperature contours of existing model

The above shown diagram represents the temperature contours of the existing model. The variation of temperature with respect to the different regions of the drying chamber is large, as the lower portion is having the greatest possible temperature and this temperature goes on decreasing from bottom to top. So that it results in unequal and non uniform heating of seeds. The temperatures of all the sections are shown by dividing into small layers which symbolizes the temperature of respective regions.

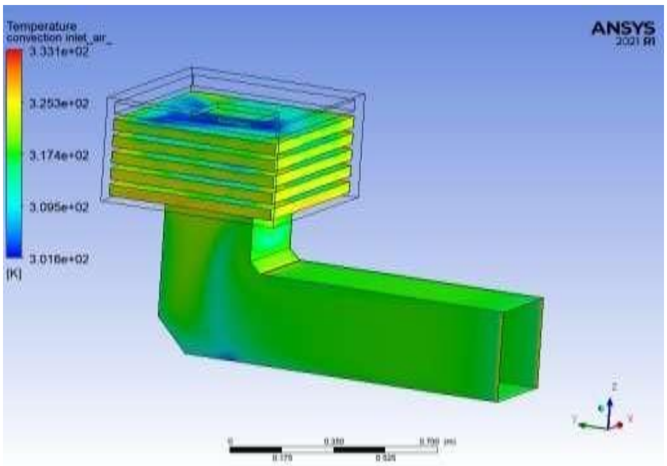

Fig-5: Temperature contours of all type seed drier

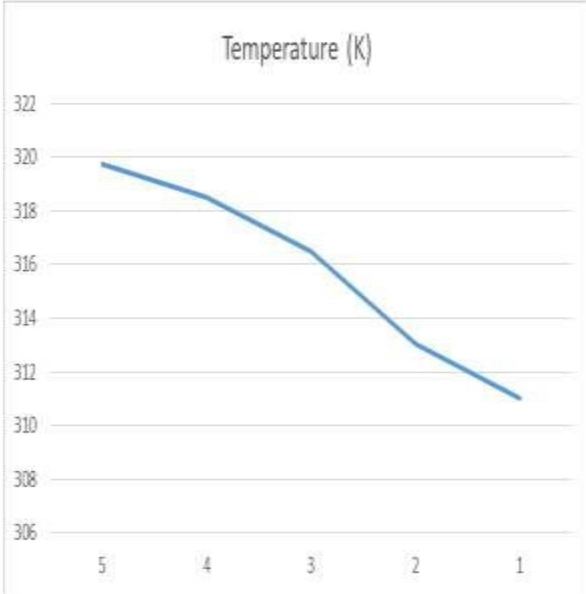

Fig-6: Graphical representation of temperatures existing driers

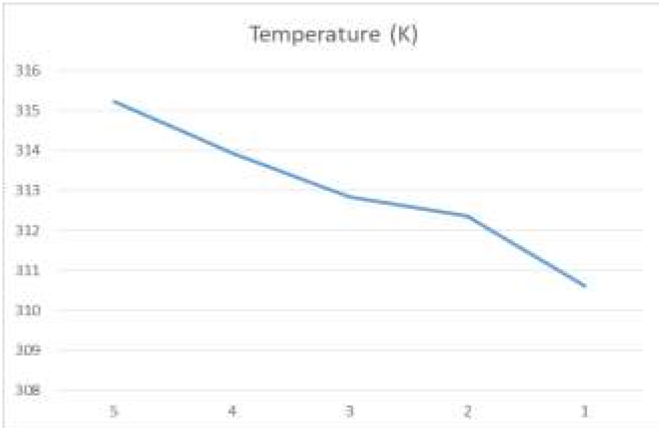

Fig- 7: Graphical representation temperature change in layers in proposed model

Table of Design Points

	A	B	C	D	E	F	G	H	I
1	Name	Update Order	P1 - velocity	P2 - layer1	P3 - layer2	P4 - layer3	P5 - layer4	P6 - layer5	Retain
2	Units		m s^-1	K	K	K	K	K	
3	DP 0 (Current)	1	1	307.51	308.89	311	311.77	311.38	
4	DP 1	2	2	310.24	313.84	314.95	315.69	315.33	
5	DP 2	3	3	311.68	315.84	317	317.8	317.5	
6	DP 3	4	4	312.59	317.34	318.69	319.37	319.14	
7	DP 4	5	5	313.41	318.56	320.01	320.67	320.42	
8	DP 5	6	6	314.09	319.73	321.09	321.7	321.46	
9	DP 6	7	7	314.69	320.54	321.97	322.58	322.39	
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Fig-8: layer wise heat transfer rate for different fan speed

CONCLUSION

The presented work intended to Numerical Performance Analysis of all Seed Dryer. A CFD analysis for improving temperature distribution in a seed dryer was presented. The continuity, momentum and energy equations were solved using the CFD software. In most of the seed dryers the air distribution duct is stopped at the bottom side of drying chamber. When using a full length air duct we can simply solve the above mentioned problem. When using a full length duct with evenly placed holes throughout it, the hot air equally distributed to all around the seed drying chamber. It facilitates uniform heating, so this can easily improve the performance of the dryer. In this work only consider the duct length and its orientation. But in future the performance of seed dryer is increased with adding preheated air. Similarly here we use air as a heat transfer medium, there are many other heat transfer mediums are available. With the use of that also improve the performance of seed dryer

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