

Tobacco Drying Mechanism Study of Temperature and Heat Physics

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Abstract - We find many applications of physics in everyday life, ranging from simple things to complex things. One example of the application of physics in everyday life is the activity of drying tobacco, when in its management there are concepts of temperature and heat. This study aims to examine the mechanism of drying tobacco based on the concept of heat which can later be integrated into the physics learning. The research method consists of observation, interviews, and documentation. The data analysis stage in this study consisted of data reduction, data presentation, and conclusions. The results showed that in the tobacco drying mechanism there is a conduction heat transfer process during the fire curing and convection heat transfer process during the air curing in the drying warehouse and radiation heat transfer in sun drying. Due to the transfer of heat into the tobacco causes evaporation so that the water content in the tobacco is reduced. The factors that cause evaporation are difference in temperature, wind, humidity, cross-sectional area, and air pressure.

Keywords: *Physics; Temperature and Heat; Tobacco Drying*

INTRODUCTION

Physics is a unit of science that is inseparable from humans and the environment. Physics is the science that discusses and explains nature and its symptoms, as well as how they interact with each other to solve a problem in everyday life according to the picture of the human mind (Masiyati et al., 2018). The concept of temperature and heat is one of the concepts of physics that is closely related to everyday life. Nevertheless, facts show that the level of understanding and knowledge of students on this material is still quite low. This is reinforced by the results of research Silung et al. (2018) that the basic concepts related to the concept of temperature and heat is a concept that is quite difficult to understand. According to Astalini et al. (2018) One of the abstract materials is temperature and heat matter which then has an impact on the low understanding of concepts in the material.

There are many applications of physics that we can find in everyday life, ranging from simple to complex things.

Often people do activities in which there is no realizing the concept of physics. One of these activities is in the local culture of an area. Local culture is a local value of cultivated people who are naturally formed. The local cultural potential of a region has a meaning as a certain resource in each region. Local potential will make the concept of physics more contextual (Agustina et al., 2018). One of the local cultures in Jember Regency is the management of tobacco plants.

Tobacco is one of the most important plantation commodities in Indonesia. This tobacco plant has potential commodities and can contribute quite a lot to national and regional income. Jember Regency is one of the regencies that has a very large tobacco farmland to be known as "Tobacco City" (Muktianto et al. 2018).

In the management of tobacco plants, to produce quality tobacco requires proper maintenance, one of which is post-harvest maintenance. One of the stages of post-harvest maintenance in tobacco is drying.

Drying is the process of transferring heat and water vapor from the surface of the material using heat energy. This drying can be done in direct sunlight (open sun drying) or with artificial drying (Hardianti et al., 2017). Community activities in carrying out tobacco farming activities are unwittingly related to the concept of physics. These physical activities can be found one of them in the process of drying tobacco. In the process of drying tobacco itself is one example of the application of the concept of temperature and heat in everyday life.

Local cultures that have been explored in the physical sciences have been revealed by several researchers before. One of the studies on the culture of the people of South Central Timor related to the concept of physics in the local wisdom of sago processing (putak) which utilizes the concept of physics, one of which is temperature and heat (Landiana et al., 2019). As for other research that integrates the local wisdom of umekbubu house into the concept of temperature and heat physics (Vivi et al., 2018). Meanwhile, the research that will be carried out by researchers is to raise the local culture of tobacco drying in Jember Regency which will be related to the concepts of temperature and heat physics.

Based on the description above, the researcher wants to conduct a study entitled "Tobacco Drying Mechanism Study of Temperature and Heat Physics" with the aim of studying tobacco drying mechanisms based on the concept of heat that can later be integrated into the physics learning. Thus, by integrating physical science in tobacco drying, it is expected that students will become more interested in studying physics.

RESEARCH METHODS

This type of research is survey research. The location used as a research place is in the tobacco drying warehouse of

Jember Regency. The selection of research locations was carried out with the consideration that Jember Regency itself is the main tobacco producing area where there is tobacco farming land and a large post-harvest tobacco processing site. The method of collecting data in this research is through direct research in the field and supporting data obtained from relevant articles or journals. The data collection method carried out according to Sugiyono (2018) is as follows:

Observation

Observation is one of the data collection methods carried out by looking directly at the field the process of drying tobacco. Observation is one of the data collection methods carried out by looking directly at the field the process of drying tobacco.

Interviews

According to Sugiyono (2018) interview is a conversation conducted by two parties, namely the interviewer and the interviewed. In this study, interviews were conducted with tobacco farmers and the interview results were used as supporting data for the study.

Documentation

Documentation is used to document everything necessary to support the research process and the discussion of the results of the research carried out.

The stages of data analysis in this study are

1. Data Reduction

Data reduction is done by selecting and selecting each incoming data from observations, interviews, and documentation, then processing and focusing all raw data to make it more meaningful.

2. Data Presentation

Once the data is reduced, the next step is the presentation of the data. The presentation of data is intended to make it easier for researchers to see the overall picture or certain parts of the study.

3. Conclusions

The withdrawal of conclusions is carried out after data analysis activities that take place in the field and after completion in the field.

RESULTS AND DISCUSSION

Tobacco is an important export commodity for Indonesia. Tobacco crops have an important role, not only as a source of income for farmers, but also for the State. Tobacco plants are annual plants, and belong to the category of plantation crops. In its management there is a harvest and post-harvest process in tobacco. One of the post-harvest management processes in tobacco is drying. There are 2 types of tobacco drying processes carried out in the Jember area, namely the first is carried out in a tobacco dryer warehouse and the second is carried out in a large field with direct sunlight.



Figure 1. Miniature Tobacco Dryer Warehouse

Tobacco dryer warehouses are commonly called atag warehouses. This warehouse has a length of 62 m, an area of 20 m, and a height of 12.9 m. A distinctive feature in tobacco plantation areas that grow na-oogst (Cigar Tobacco) tobacco is this atag warehouse. The shape of this warehouse

building is a kind of long los made of bamboo with weeds and grounded. The frame of the warehouse is made of bamboo and the roof is made of reeds to create air circulation, temperature and humidity of the air that is not too volatile during the drying process. The process of drying tobacco in this drying warehouse is carried out by obtaining heat from burning firewood to increase the temperature in the drying process as well as opening the dryer shed ventilation to enter fresh air from outside the dryer shed and removing moisture from inside the dryer shed (Josi et al., 2018). In this dryer shed there are many poles in the middle. The existence of such poles is used to hang tobacco leaves. In the building of this dryer shed maximizes the process of drying the air.

The drying process is the process of decreasing the moisture content of a material so that the moisture content is equal to normal temperature (Henderson & Perry, 1982). Drying is the process of simultaneous transfer of heat and moisture (Taib et al., 1987). The purpose of this drying process is to reduce water content to a certain extent and inhibit the rate of material damage due to biological and chemical activities (Brooker et al., 1974).

The drying mechanism carried out in the warehouse uses a suction system and water curing (air circulation). Drying in the dryer shed is carried out for 21 days. The first thing that is done before the drying process is the process of sujen, which is tobacco petioles in the sunduk. After that, the tobacco that has been ordered is then hung over each room. Each dryer shed is divided into several rooms with a width of 2 meters.



Figure 2. Tobacco Drying in Dryer Shed

The initial process of drying is characterized by the loosening and yellowing of the leaves. Then on the 3rd to 5th day given heat treatment (oven with chaff) this aims to warm the room in the warehouse at night so that the process of leaf casting occurs. Then on the 6th day there is no fumigation process. This is done to provide opportunities for the leaves to process naturally. Furthermore, on the 9th to the 15th day, the provision of slow fire using chaff and wood. This aims to help the process of lamina and drying the handle of the leaves. On the 16th to 20th day the process of giving a medium fire aimed at drying the handles of tobacco leaves.



Figure 3. Fire Drying Process

The drying process in the warehouse is also equipped with a hygrometer to control the humidity of the air in the warehouse. If the humidity in the warehouse is too high, then smoking action is carried out and if the humidity of the air is too low, the action of

discussing the warehouse floor with a sprayer machine is carried out. The fumigation process is usually carried out at night, while in the morning it is treated to open the window lid aimed at maintaining the stability of moisture in the warehouse. The humidity needed in the process of drying tobacco is 80% until the age of 15, while at the age of 16-21 the humidity needed is about 50-60%.

The following is an exploration of the concepts of temperature and heat physics in the mechanism of tobacco drying:

Conduction Heat Transfer

Heat transfer by conduction is the process of displacement between two objects that touch each other. Heat will move from higher-temperature objects to low-temperature objects. This transfer of heat by conduction heat flows heat without the movement of substances or objects, but through one type of substance (Syaiful, 2018). Heat transfer by conduction at the time of drying tobacco is when the fire curing process. The fire curing process is carried out to keep the evaporation process running. When the fire curing process takes place, the air temperature in the tobacco warehouse rises then the tobacco will absorb the heat emitted by the heat from smoking. The additional energy from the suction heat causes the kinetic energy of the water molecules in tobacco to increase. As kinetic energy increases, water molecules move faster. Once the kinetic energy reaches a certain value, the water molecules in tobacco will turn into water vapor. This process continues to repeat until the tobacco's water content is reduced.

Convection Heat Transfer

Convection heat transfer is heat transfer due to movement or flow from the hot part to the cold part (Giancoli, 2014). The process of heat transfer by convection

occurs during the process of opening the window lid of the dryer shed. Convection that occurs is free convection caused by a difference in density due to a difference in air pressure. When the warehouse window is opened in the morning to noon, there will be a temperature difference between outside the warehouse and inside the warehouse. When the air in the dryer shed rises, it will also increase the relative humidity of the air so that it is able to lift moisture from tobacco that is heated by the air.

Radiation Heat Transfer

The drying process carried out in direct sunlight is carried out for approximately 4 days. The first process before tobacco is dried is the process of *sujen* (tobacco leaves are drawn with bamboo). Then the tobacco is dried in direct sunlight. The drying process starts at 06.00 to 16.00.



Figure 4. Sun Drying Tobacco

Heat transfer by radiation is heat transfer without the need for a medium for the process of moving. Drying tobacco

carried out in the field (under direct sunlight) is done with solar heat radiation received by tobacco and the evaporation process occurs until the tobacco water content is reduced. Because of the difference in temperature in the sun which has a higher temperature and the earth that has a lower temperature, it causes the transfer of heat from the sun to the earth in the absence of a medium. The rays of sunlight entering the earth through an atmosphere. In this radiation transfer heat energy derived from the sun is flowed on the earth's surface in the form of electromagnetic waves. If the energy radiation hits the surface, then some of the radiation will be reflected or reflected, some will be absorbed and some of it will be passed on.

Evaporation

The existence of a heat transfer process that occurs in the drying process of tobacco which can then cause evaporation. Evaporation is the process of converting liquids into gases. Evaporation involves changing the phase of water from liquid to gas or referred to as water vapor. Here are the stages of evaporation; Heat obtained from energy sources both hot air, heat directly from metal conduction or solar heat will be absorbed by a material so that later the water contained in it will evaporate. The water vapor will then pass through the structure of the components of the solid material so that it comes out and the moisture content in a material will be reduced (Waziroh et al., 2017). The factors that cause evaporation in tobacco drying are as follows:

1. Temperature

Temperature is one of the factors that affect the rate of evaporation. The higher the air temperature, the higher the kinetic energy of water molecules. It is this high energy that causes water molecules to move in the form of steam into the layer of air above them. So

in the drying of this tobacco, when the air temperature in the dryer shed and the temperature of the outside air is high there is heat transfer that can cause the kinetic energy of water molecules in tobacco to turn into water vapor and the water content in tobacco is reduced. The temperature required in drying in tobacco warehouses is about 30°C-35°C while drying directly under sunlight the maximum temperature is 42.5°C.

2. Humidity

High air humidity can inhibit the process of evaporation. While low air humidity spurs evaporation. Therefore, drying in tobacco takes a little longer compared to drying under the sun. Drying in the warehouse requires high air humidity while in direct drying the humidity of the air around is low. The humidity needed when tobacco is dried in the dryer shed is 80% on days 1-15 while on days 16-21 the humidity needed is 50%-60%. When tobacco is dried directly in the sun the ambient air humidity is 33% to 42%.

3. Wind

When evaporation occurs, it will make the evaporation surface air become saturated (moist) against water vapor so that it can cause evaporation to be stopped. In order for evaporation to continue, the saturated air layer must be replaced with dry air. This happens when there is wind. therefore, drying tobacco in the warehouse, done by opening and closing windows, this is done to get air circulation assistance and let tobacco dry naturally. Based on data downloaded through weather online stations, the average wind speed in tobacco dryer areas ranges from 8 km / h. While the average speed in the dryer warehouse area is 14.8 km / h.

4. Air Pressure

When the air pressure above the surface of the material is lower than the air pressure on the surface of the material, it will

cause evaporation. There is a difference in air pressure, water vapor will combine with the air above the surface of the material and make the air has water vapor content. The air pressure in the area around the tobacco dryer ranges from 1,012 hPa.

5. Cross-sectional Area

The cross-sectional area is very familiar with the evaporation process, the liquid will evaporate faster in a wide but shallow cross-section than a narrow but high cross-section. So that the drying of tobacco is directly carried out in a large field and placed in a row in order to speed up drying.

The local culture of an area is a local value obtained from the results of the learning process over time and develops from the results of community cultivation in an area. Local culture plays a role in the learning process, namely as a learning resource in a living environment that demands active interaction between teachers and students.

The concepts of temperature and heat physics in the tobacco drying mechanism can be integrated into physics learning that can be adjusted to the basic competence of physics in high school. the relationship between the tobacco drying mechanism and the basic competence of physics in SMA, namely in basic competence 3.5 Analyzing the influence of heat and heat transfer which includes the thermal characteristics of a material, capacity, and heat conductivity in everyday life. So that it can be integrated into contextual physics learning based on local culture. The application of local culture in this study aims to introduce and preserve local culture to students who are later expected to be able to understand and get to know the local culture of the region.

Some factors that can influence the success of the learning process are the learning methods and learning resources used by educators. learning by utilizing local

culture is useful for increasing students' knowledge and understanding (Shufa, 2018). The concept of heat in the local culture of tobacco drying can be useful for learning that can make students more familiar with the culture that exists in the community as a source of learning. This learning can make students give meaning to what is seen, heard, and learned from the cultural heritage. In addition, students can find out the role of the local culture of a region in a learning process that can make students easily understand physics concepts that are considered difficult (Landiana et al., 2019).

CONCLUSION

Based on the data obtained from the results and discussions, it can be concluded as follows:

The mechanism of drying tobacco based on the concept of heat is the occurrence of heat transfer process by conduction during the fire curing process in the dryer shed and there is a process of transfer heat convection, namely when drying is carried out by air circulation through the opening of the window lid. Then radiation occurs when tobacco is dried in a large field under direct sunlight. With the transfer of heat, the water molecules in tobacco evaporate (evaporation process occurs) until the water content in tobacco is reduced. The factors that cause evaporation are temperature, humidity, wind, air pressure, and cross-sectional area.

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