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A DOUBLE FUNCTION EQUIPMENT OF A DRYER CONCURRENTLY A WATER DISTILLER BY SOLAR AND WIND ENERGIES FOR THE DEVELOPMENT OF COASTAL AREAS

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ABSTRACT

The aim of the study is to create double-fuction equipment comprises the use of a dryer in the rainy seasons and of water distillation in dry seasons.

The main components consist of a windmill as the source of mechanical power to move the blower or water dipper and a drying room doubling as a distilling room by solar energy.

Keywords : dryer, water distillation, mechanical power, solar energy.

I. INTRODUCTION

Common problems faced by the people on coastal areas who generally are fishermen and peasants are :

1. Springs on shore generally are salty, so to fill the need for fresh water especially for drinking, is to bring fresh water from inland areas, quite some distance from the coast, or collect the rain water in the rainy seasons. As the need for fresh water is so great in the dry seasons, apparatus to produce fresh water is urgently needed .
2. The drying of sea products, especially fish and agricultural products for processing or for conservation are usually carried out in the sunlight, which is of course impossible to do in the rainy seasons. Thus, facilities for drying equipment are needed in this period.

Disregarding the problems of first investment, to develop equipment there arises the problem for routine expenses especially for the power supply. The writer considers solar and wind energies are the cheapest means that can be used.

1.1. Drying of material

The drying of a solid substance is part of process for conservation. The purpose of drying agricultural products, such as paddy corn, coffee, and so on, is to obtain dried materials so that the following process (milling) can be done well and good quality can be achieved. Drying of sea products, especially fish, is the most common method for fish conservation.

The speed of drying is proportional to the speed of water evaporation from the material to the air. From the point of mass movement the speed of evaporation particularly depends on the coefficient of mass transport of vapour from the material surface to the air, and the difference of

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moisture content of the air on the material surface with the moisture content of the air which flows out of the material.

From the point of heaving movement, the speed of evaporation depends on the coefficient of thermal movement (conduction, convection, and radiation), and the difference of the material surface temperature with the air temperature of the surroundings.

In the model of a dryer which uses an air cavity, the arrangement of air to the drying room can be done in three ways :

- Air is heated first, then delivered into the drying room and further to the outside, meaning there is no air circulation.
- Not all the air is vented. The air which has come out from the dryer is re-heated, then re-circulated into the drying room. This method is not profitable because when the air is already saturated, the evaporation will be delayed.
- The humidity in the drying room should be constant; this is carried out by venting some circulated air and taking in fresh air from outside.

In this case, considering that this equipment is especially designed for the coastal community, the writer has selected the first methode for the reason that the introduction of air into the system is the simplest. Thus, the structure of the equipment being simpler, the control and the operation will be easier too.

1.2. Water distillation

Getting clear water from a dirty spring (not salty) is usually carried out by physical and chemical processes, among others : precipitation with or without coagulation, cleaning and addition of disinfectant.

If the spring is salty, to get fresh water is done by ways of : distillation, electrolysis and kation & anion exchange, but at great expense. To overcome this, considering that Indonesia is situated on the equator, has coastal areas which are usually open lands receiving abundant solar radiation, the writer suggests that the distillation of salty water by solar energy should be developed.

II. THE MAIN COMPONENTS OF THE DESIGN

2.1. Drying Room

Drying can be carried out in a batch process, that is in a drying sequence which consists of : the entering of the wet material, the drying process and the release of the dried material. The continuous action of a series of drying operations, the entering of the wet material or the release of the dried product is done continuously so that complex equipment and a more accurate schedule are needed to obtain the appropriate dryness of material.

The writer is of the opinion that if this equipment will be used for drying of many kinds of materials, it would be more flexible if the operation is a batch process.

The drying room is made of clear acrilyc (available in the market) in a dome shape, material for heat storage such as pieces of broken tiles or ceramics, gravel, or coral is placed inside the drying room. This room is aerated by a blower so that the air has a contact with the dried material which will hasten the evaporation of moisture, and later the air blown outside.

This can be done by way of using air heating room, and the hot air which comes out of it is introduced into the separate

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drying room. To choose between these two systems, further research is needed. Considering simplicity of equipment and construction expenses, the writer chooses the first model, the dome room doubling as a drying room.

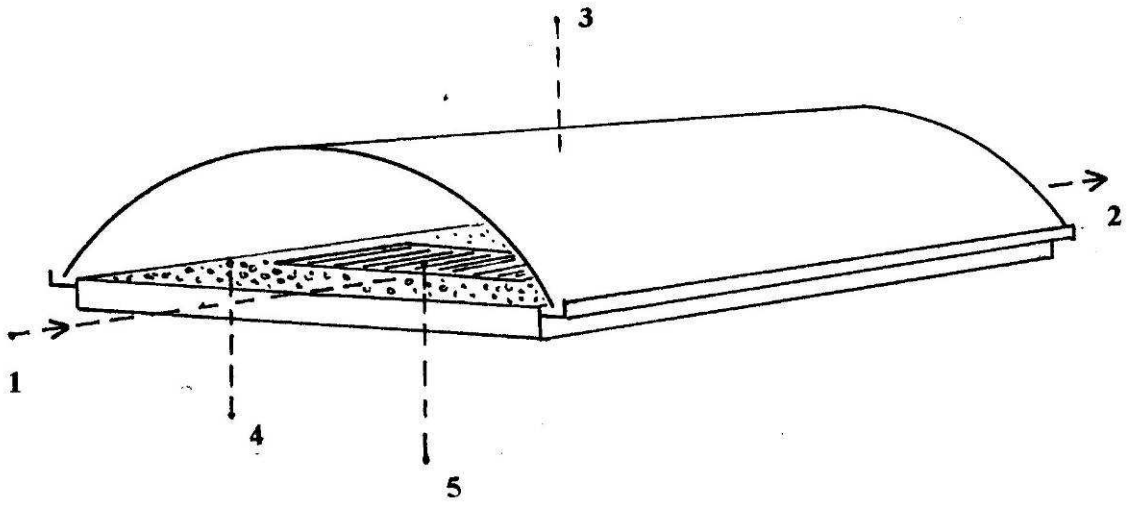

Figure 1. Drying room.

The description of the figure :
1 : Air flows in from the blower.
2 : Air flows out of the drying room.
3 : The drying roof is made of clear acrilyc.
4 : The filling : coral
5 : Material to be dried

2.2. The water distilling room

Generally the process of water distillation consists of two stages, those are : the stage of evaporation which takes place in the evaporator and the stage of condensation which takes place in the condenser.

There are two models of water distillation by solar energy ;
a. The distillation equipment where evaporator and condenser are separated.
b. The distillation equipment where evaporator and condenser form one unit.

Considering simplicity of construction in order to be easily copied by people, the writer chooses model b.

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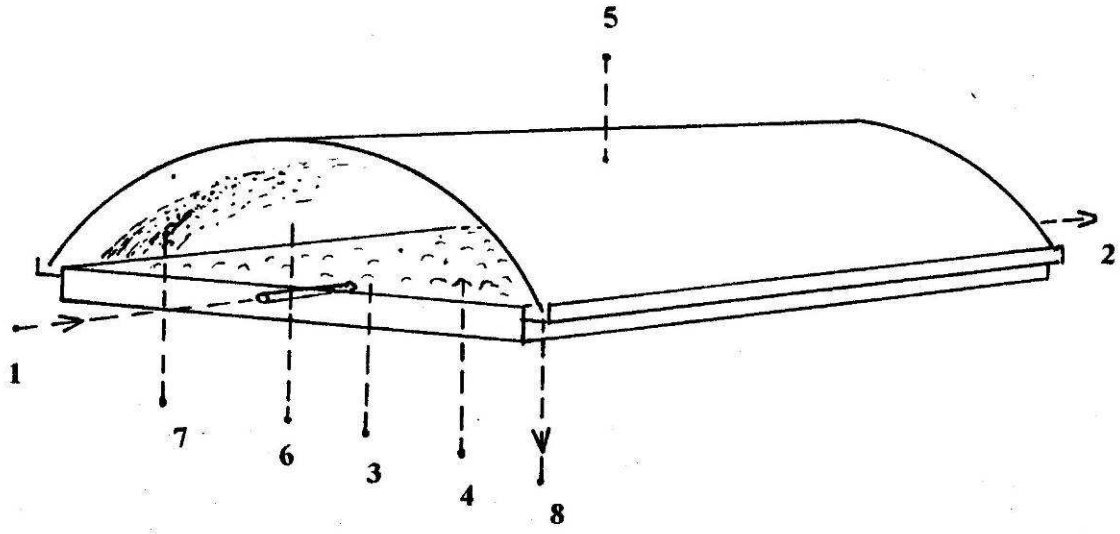

Figure 2. Water distillation room.

The description of figure :

1. Salty water flows in pump or dipper continuously.
2. Thick salty water flows out continuously.
3. Salty water vessel.
4. Part of the surface of the filling material is protruding from the water surface but still wet so as to enlarge the evaporation surface.
5. The curing roof (wall) of clear acrilyc.
6. Evaporating room.
7. The condensing container (inside wall/ roof), so that the condensate will flow down into the cannal (left & right).
8. Channel for delivering fresh water into the storage vessel.

2.3. Mechanical power

Considering that this set up is especially for coastal areas which are generally open lands with lots of wind, and because of low operational expenses, the writer considers best to benefit from wind energy as the source of mechanical power. By a windmill, wind energy is changed to mechanical power.

The purposes of mechanical power in this design are :

1. To move the blower which is used for blowing the air, when the equipment functions as a dryer.
2. To move the pump or rotating the dipper to raise or to fill the salt-water basin when the equipment functions as a still.

2.3.1. Windmill

Kinds of windmills, among others are :

a. Snail shell model

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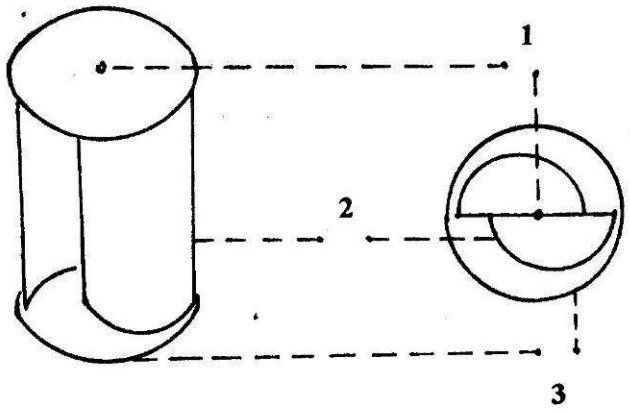

Figure 3. A snail shell windmill.

Discription of figure :
1. A stationary axis.
2. Curving blades (half circle)
3. The cover, as stabilizer of curved blades.

The rotation of this mill is relatively stable, and does not depend on the air direction; however, to make it start, some outside force is sometimes needed.

b. Propeller model (like airplane propeller).

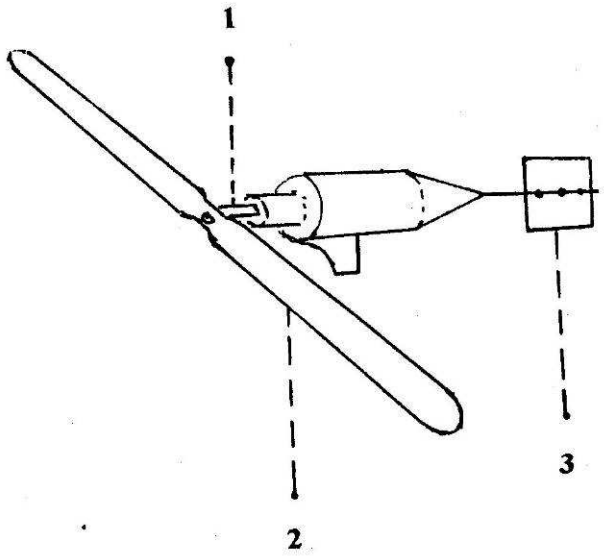

Figure 4. The propeller windmill.

Discription of figure :
1. The rotating pivot.
2. The propeller blades.
3. The fan to adapt to air direction.

The number of propeller blades can be 2, 3, 4, or more; to decide which is the most effective, further research is needed.

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2.3.2. Blower

The blower is used for delivering air into the drying room. For a blower of this design it is not required to produce high pressure, but the amount of air mass which can be moved should be great. The model of blower which is normally used is a centrifugal blower.

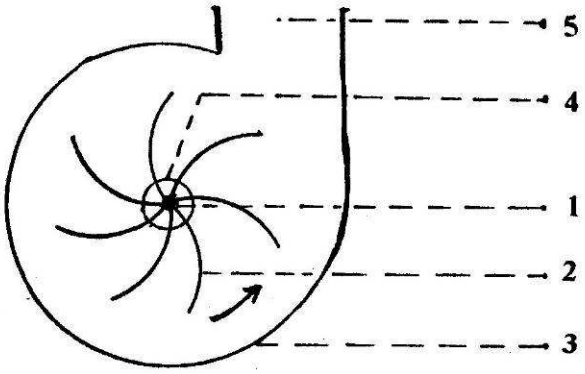

Figure 5. Centrifugal blower.

Description of figure :
1. Pivot.
2. The propeller blade.
3. The blower shell.
4. Air entrance hole.
5. Air exit hole.

2.3.3. The rotating dipper

To fill the vessel in the distilling room from the salty spring nearby, pump and dipper are used. If the spring is relatively deep compared to the surface on which the equipment is constructed, a pump is used. If the spring is near the surface-usually on the coastal areas where there are plenty of salty springs – it is enough to use a dipper, for instance a rotating dipper.

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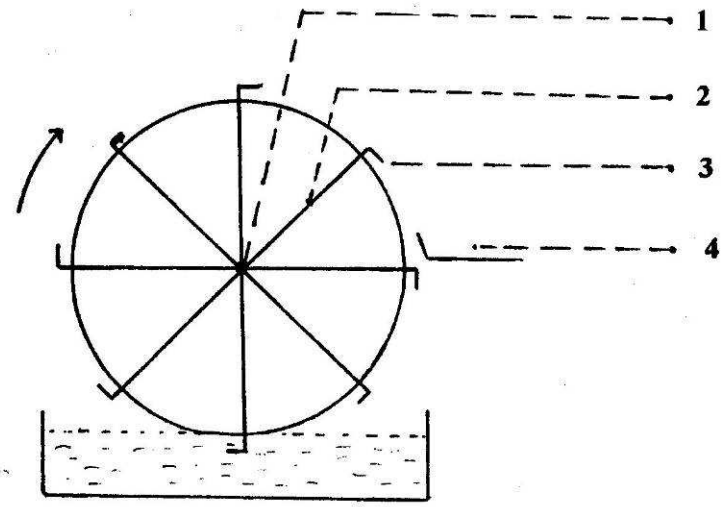

Figure 6. The Rotating Dipper.

Description of figure :
1. Axis
2. Supporting spokes.
3. The water dipper.
4. Channel for delivering water into the vessel.

III. EQUIPMENT INSTALLATION AND OPERATION.

3.1. The equipment is used as a dryer

Material is put into drying room. The rotating axis which is moved by the windmill is connected with the blower axis in order to deliver air into the drying room. Solar energy which touches the dome roof, is absorbed and delivered into the drying room, half for drying the material ang the other half for heating the substrata. When the material is considered dry, it is released from the room and is changed with other material to be dried.

3.2. The equipment used as a still/ water distillation

The equipment which is used as dryer, when changed to distillation equipment needs to be cleaned first, especially from the remains of the dried material in order not to have decay. The rotating axis which is moved by the windmill connected by the rotating dipper axis, is to raise water from the spring to the basin into the distilling room continuously. Solar energy which touches the dome roof is

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absorbed and energy is delivered into the distilling room, so that the process of evaporation takes place. Vapour which moves upwards is barred by the lower dome roof, gathered, and the process of condensation takes place. The condensation flows down the inside walls and is collected in two channels which are situated on the ends of the left and right hand roofs, and subsequently flows into the collecting basin. If the function is to be changed to a dryer, all the water in the vessel must be removed first.

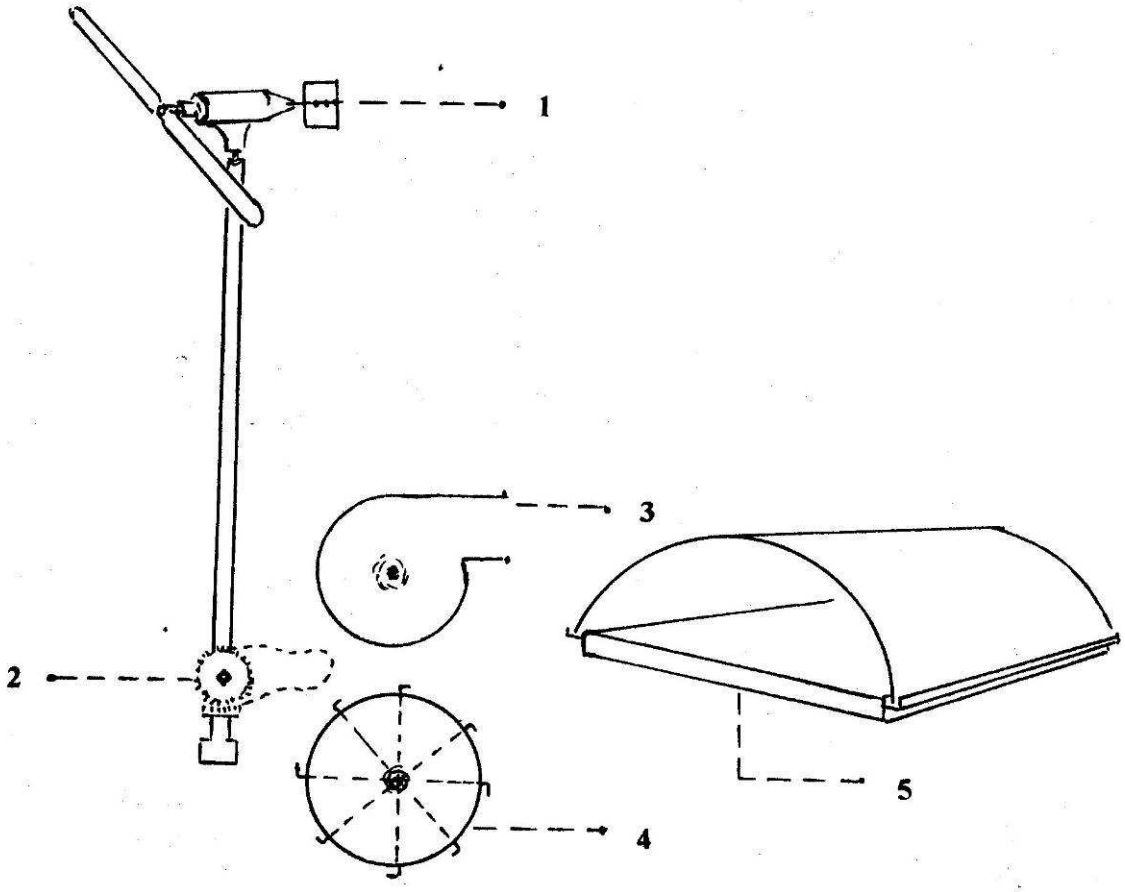

Figure 7 : The equipment as a dryer or still

Description of the figure :
1. Windmill
2. Mechanical motor connection
3. Blower
4. Rotating dipper
5. Drying room/still

IV. CONCLUSION

This double function facility is used all year round, as a dryer mainly in the seasons, and as a still mainly in the dry seasons.

The main difference in the two applications is : as a dryer, a blower is used

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to deliver air into the drying room, whereas as a still, dipper is used to fill the vessel in the evaporating room.

For an inproved program, especially for improving capacity and the operational conditions, further research is required.

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