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EXPERIMENTAL STUDY OF DRYING OF A MEDICINAL PLANT (ANTIOXIDANT GINGER) BY SOLAR PANELS HAS VARIABLE CHICANE

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ABSTRACT

Solar Panels Application For Low thermal drying is the level of exchange with the air in the use of dynamic thermal vein panel Pour them improve heat transfer. A fin Improve the relationship between the temperature and the thermal efficiency of a solar panel system and air drying to reduce drying time ginger.drying of the plant by the medecinal Solar panel variable baffle the result and retain the quality of the fiber after drying It can be used to fight infections, fatigue, muscle aches and especially digestive problems (vomiting, diarrhea...). Ginger also has aphrodisiac properties, antioxidant and antibacterial.

KEYWORDS: Solar Energy, Simulation, An Air Heating Plane Solar Panel, Temperature and Thermal The Solar Panel, Drying, Ginger

INTRODUCTION

The study of the performance of solar panels variables baffles allows the thermal losses between the absorber and the limited environment. Recent studies have placed a special emphasis on the flow of refrigerant as a means of optimizing performance.

Methods have been proposed to deal with this objective. Zugary and Vulliere [1] sought to limit the losses near the fore part of the solar panel; two other researchers [2, 3] centred their work more on the absorber. The research [2-8] showed that placing baffles in the dynamic air stream of the solar sensor variable baffles allows turbulent air flow created which in turn stimulates the exchange of heat convection between air and absorberl'étude the performance solar panels floating baffle allows the thermal losses between the absorber. the results are improved due to the reduction of the hydraulic diameter (Dh) relative to the performance of solar panels without baffles. In the air flow passage, the Reynolds number is calculated on the basis of the maximum velocity (Vm) which corresponds to the minimum air flow duct section (Smin) and resolved by suivavnte equation:

$$Re = \frac{V_m . D_h}{\nu} = \frac{Q_V . D_h}{\nu . S_{min}} \quad \text{with} \quad D_h = \frac{2d\ell}{d+\ell}$$

$$\text{By} \quad d \ll \ell \;\Rightarrow\; d+\ell \approx \ell \quad \text{so} \quad D_h = 2d$$

Posing $b' = 1\frac{S_{min}}{d\ell}$ we are $Re = \frac{2Q_V}{\nu.\ell.(1-b')}$ (1)

D_h: the hydraulic diameter of the duct

b': the blockage coefficient in the air vein

The coefficient of heat exchange by thermal convection (HCCF) is a function of the Reynolds number; it is an increasing function Re, h does not increase. When b increases', both Re, HCCF, increase. The minimum air flow duct section (Smin) is dependent of the shape of the baffles, their dimensions and their arrangement with respect to each other. The following three position fasteners solar collector has baffles variables were studied:

The flow becomes turbulent and girls structures vortex takes place very close to the absorber to which air is oriented and heat transfer is improved. the heat transfer capacity from the surface of the absorber increases, and improving the efficiency of the solar panel has variable baffles. forms already studied [2], the results showed that with low air flow, efficiency increases, while air with high flow rate at a given value, efficiency tends to decrease. When the air flow is very strong, vortex bursting are much more obvious near the insulation material. This positioning of the baffles results in a less efficient performance. Indeed, at the ends of the blades, the air temperature is lower than it is in the abosrber.

- To improve the performance of this second position, some of the intermediate baffles can be fixed on the insulating material which will carry the airflow to the absorber [2]. In this case, the losses in the solar panel will be higher and will increase its thermal inertia.

The shape of the baffles affect the flow of air during its trajectory. The absorber is well irrigated, reducing inertia areas, creating turbulence and lengthen the path of the air in the solar panel variable chicane. A careful and systematic study of several different methods of arrangement of the air flow paths in solar panels

The first part of this study deals with a comparison of the results, first using solar panels without baffles (SC) and with varable baffles. Of these, two types have been selected, namely dual longitudinally curved Delta platform (DCL1) and shaped Ogival Curved longitudinally (OCL1) varable baffles. The second part concerns the results obtained using first solar panels without baffles and with DCL1 baffles for GINGER drying. In addition, to conduct experiments that highlight the effects of baffles even further, Ginger (madicinal the plant) were dried using a solar panel provided with Transversal-longitudinal (TL) of the same type those already studied [4]. A comparison of the results shows that the solar panel with variable baffle is much more efficient.

EXPERIMENTAL DEVICE

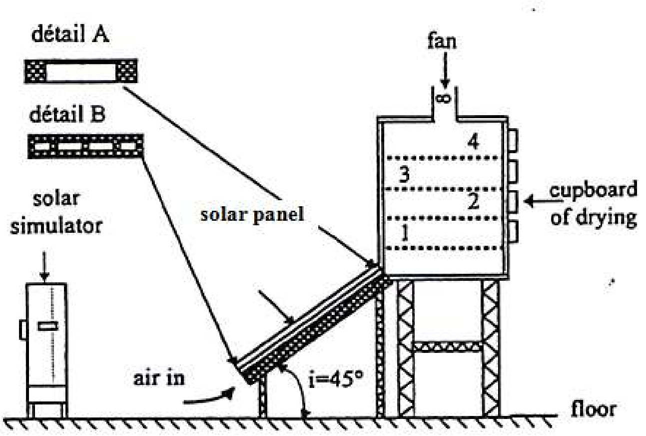

Figure 1: Experimental Device

The solar panel has variable baffle with an air stream consists of (Figure. 2) a transparent, with air passage, polycarbonate cover 1 cm thick.¬ transmission coefficients (tc) and emissivity (lseau) t are respectively 90% for wavelengths varable➢ absorbers composed of a aluminum foil having a thickness of 0.4 mm Thermal conductivity (aA) and absorption (Ka) coefficients are respectively 95% and 205W / M.K. The distance (d) on each side of the absorber is 0.025M. a 5cm material that can withstand temperatures of 90 ° C. The¬ coefficient of thermal conductivity (Kis) is equal to 0.04 W / M.K.

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- A 5 cm material which can resist temperatures higher than 90°C. Its coefficient of thermal conductivity (K_{is}) is equal to 0.04 W/m.K.

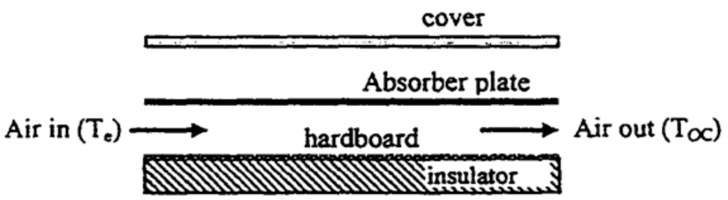

Figure 2: Solar Air Flat Plate Collector without Obstacles

Too, the shape of the inlet (details A) and outlet (details B) of air of the solar panel have to be carefully arranged so as to avoid heating any dead zones. The baffles are fixed on a hardboard sheet just above the polystyrene plate. The experiments took place at Valenciennes in North-East France, the co-ordinates of which are : latitude : φ = 50.3°; altitude :

Z = 60 m; longitude : L = 3.5°, and on a day in July which was considered typical of mean solar time flux (Figure. 3) and which corresponds with the average for the years 1998, 1999 and 2000 [9].

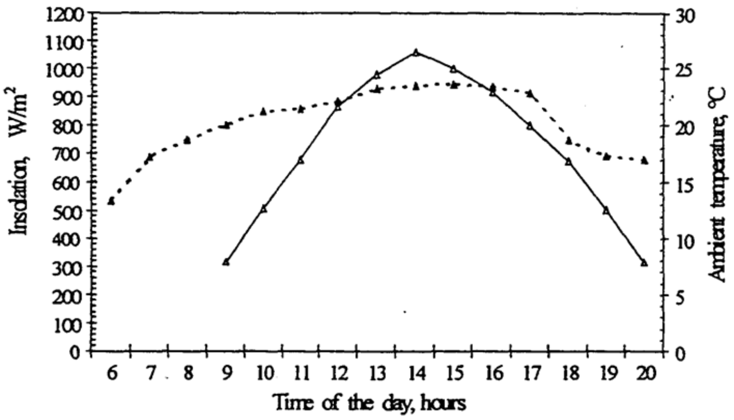

Figure 3. Variation of the ambient temperature and the insolation during the characteristic day of July, at Valenciennes —△— global hourly insolation (I_{GS}); -▲- ambient temperature (T_a)

RESULTS AND ANALYSIS

Improvements to the Ratio between Temperature and Thermal Efficiency

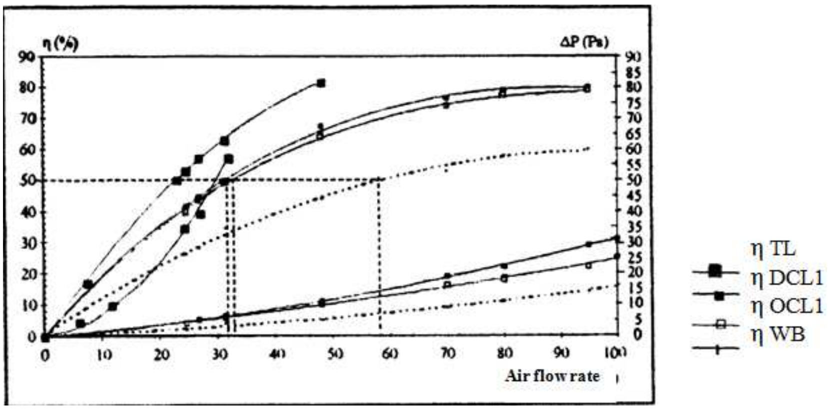

Figure 4 : Evolution of Thermal Efficiency (Where I_{GS} = 1063.5W/m²) and Charge Losses in Relation to Air Flow as Concerns WB Solar Panels and those Provided with Different Types of Baffles (*I.E.* DCL1, OCL1 and Then TL), as at the Valenciennes Site

However, the blocking effect of TL baffles enables a very turbulent flow to be created and, consequently, provides a very good level of thermal interchange. It is worth noting that the resultant charge losses are very high because the air flow through the duct is very weak compared with that attained with other types of baffles. A thermal efficiency of 50% obtained with a specific flow of 23m³/h.m² corresponds to a temperature (T_{WB}) of 104°C, *i.e.* an improvement in temperature (T_e) of 75°C at the solar panel inlet. These results are decidedly better than those obtained when using DCL1 or OCL1 type baffles. The lengthening of the distance covered by the air in the solar panel duct results in an even better interchange of heat between the coolant air and the absorber.

Improving Drying Time

Dating from the early research work of Lewis in 1921 [17] and Sherwood in 1929 [18], techniques of drying have been the subject of many scientific publications and continues to be a priority field of research, especially in respect of countries where traditional methods remain in use and are essential for want of better. As it is readily available at little or no running costs compared with other sources of energy such as electric resistors [19], solar energy is obviously an alternative. At Valenciennes, simulated solar energy was used to carry out experiments applied to drying pre-dried GINGER; the simulator was conceived to provide conditions of a typical July day.

For solar energy to be harnessed effectively, certain difficulties have first to be overcome and to be achieved with the help of technically viable and economically profitable systems. The choice of the type of dryer is conditioned by whether or not the product in question can withstand solar radiation; it also has to be made between direct or indirect dryers and depends, too, on the commercial value of the product. Since the performances of absorbers are higher than the thermal conversion capacity of the product, the use of an indirect dryer is the more effective. The system under study is therefore an indirect solar dryer functioning by thermal forced convection.

The quantities of heat (Q_u) recovered by the coolant fluid, as far as the absorber is concerned, depends on the efficiency of the solar panel used. Given that these quantities are proportional to the variations in temperature between the inlet and the outlet of the solar panel, the results presented above show that a solar panel provided with baffles functions more efficiently and so baffles are essential fittings because they reduce drying times.

In our experimental work, the objective is to carry out drying by a simulation of solar energy. However, for a given air flow, we wanted to study the variations in certain parameters of the drying process as at different times during the typical day under consideration. In view of the considerable expenditure that could be involved in setting up a real-life operation, the use of thermal forced convection would seem to be less suitable in applying the findings of our small-scale experiment to a large-scale situation. Nevertheless, it would be profitable to take advantage of natural convection in a solar chimney. Its application is, of course, all the more valid in geographical zones deprived of electrical power. The choice depends on several factors, including the quantity of the product to be treated The choice between forced and natural convection depends on several factors, in particular on the quantity of the product to be treated, on the capillary structure of that product and its nutritional value while not neglecting the financial budget available. Drying time is indeed of paramount importance. As regards large-scale {industrial} concerns, an external source of energy is required. Where electrical power is available, even if weak but at an affordable rate, it is logical to make use of it to actuate the ventilators, blowers or other devices necessary to increase the efficiency of the system. Where a system functions with natural convection in a solar chimney, the driving force of gravity is created by differences in the density of air between the exterior {ambient conditions} and the interior of the chimney. The height of the chimney, which influences the efficiency of extracting air, is a factor that has therefore to be adequately investigated. Pasumarthi and Sherif [20] have shown that for a given height and an increasing solar flux, the temperature at one and the same given point in the chimney also increases. Heat interchange improves but the total charge losses of the system, which are proportional to the height of the chimney and to the differences in air density, increase considerably.

Prior to setting out the findings of our experiments, a brief description of the type of TL baffles used is called for. The height of the large (transversal) baffle is 2.5 cm and that of the small (longitudinal) one is 2 cm (Figure. 5). The surface A_C is1.28 m².

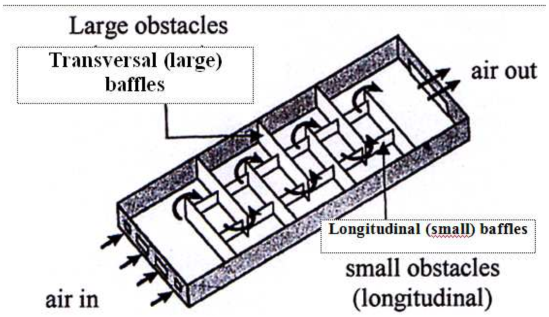

Figure 5: Solar Panel Equipped with TL Type Baffles

[Kge/KgMS: kilograms of water per kilograms of dried mass of the product]

To study the influence of the flow of drying air on drying time, it was considered of value to use two flows, one of 31.3m³/h.m², the other of 70m³/h.m². This adjustment is made with the help of a ventilator (solar simulator). The air flow is measured using a "Jules et Richard" anemometer with a 10 cm diameter propeller. With a flow of 31.3m³/h.m², drying times at the first (bottom) tray (Figure. 1) take up to 8 hours as regards the solar panel fitted with DCL1 baffles, 6 hours 35 minutes for that with TL baffles while the longest time taken was with the WB solar panel. There are therefore reductions of drying time of 49% and 59% in comparison with the WB solar panel. The final content of water collected in the WB solar panel is only attained after 14 hours 10 minutes of drying time (Figure. 6). The air coming from the level of the first tray is still heavy with moisture and, consequently, for this same air flow, drying time at the level of the fourth (top) tray takes longer for all three types of solar panels used. By increasing the flow to 70m³/h.m², drying times decrease in each of the three solar panels. As drying is brought about by force of speed of the flow, this faster flow results in a more rapid evacuation of the moist air.

By increasing the flow from 31.3m³/h.m² to 70m³/h.m², and as regards the solar panel with DCL1 baffles, the drying time at the first tray is reduced by one hour, *i.e.* a relative reduction of 15 % whereas a relative reduction of 13.8% is attained using a solar panel with TL baffles. The drying times at the level of the fourth tray are respectively 10 hours (DCL1 baffles) and 8 hours (TL baffles). Comparing these results with the performance of the solar panel without baffles, and with a flow of 70m³/h.m², the reductions in drying times at the first tray are respectively 27% and 39.5%.

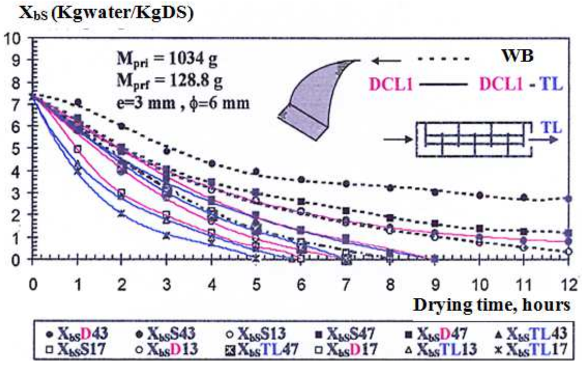

Figure 6: Evolution of the Water Content (X_{bS}) in Relation to Drying Time Measured at the First and Fourth Trays with Flows of 31.3m³/h.m² and 70m³/h.m² using WB, DCL1 and TL Type Solar Panels, Data Recorded on a Typical July Day at the Valenciennes Site

A graph (Figure. 7) plots the evolution of the loss of mass (ΔM) at each hour, for each of the two flows and for each of the types of solar panel used. Figure. 8 shows the evolution in temperature of the product (T_{Pr}) in relation to the passage of time during the drying process. It is to be noted that for every type of solar panel used, drying takes place at temperatures that vary in accordance with the solar time flux particular to the day on which the experiment is conducted. In every case, a constant phase of drying cannot therefore exist (Figure. 9).

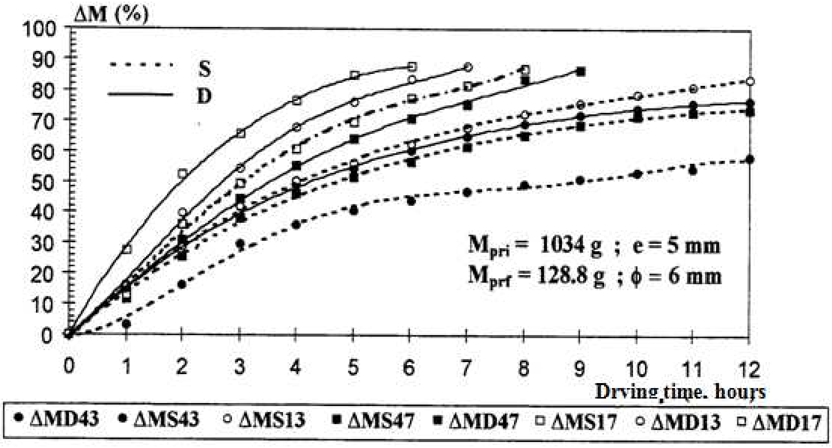

Figure 7: Evolution of the Loss of Mass (ΔM) of Plums in Relation to Drying Time Measured at the First and Fourth Trays with Flows of 31.3m³/h.m² and 70m³/h.m² using DCL1 and TL Type Solar Panels, Data Recorded on a Typical July Day at the Valenciennes Site

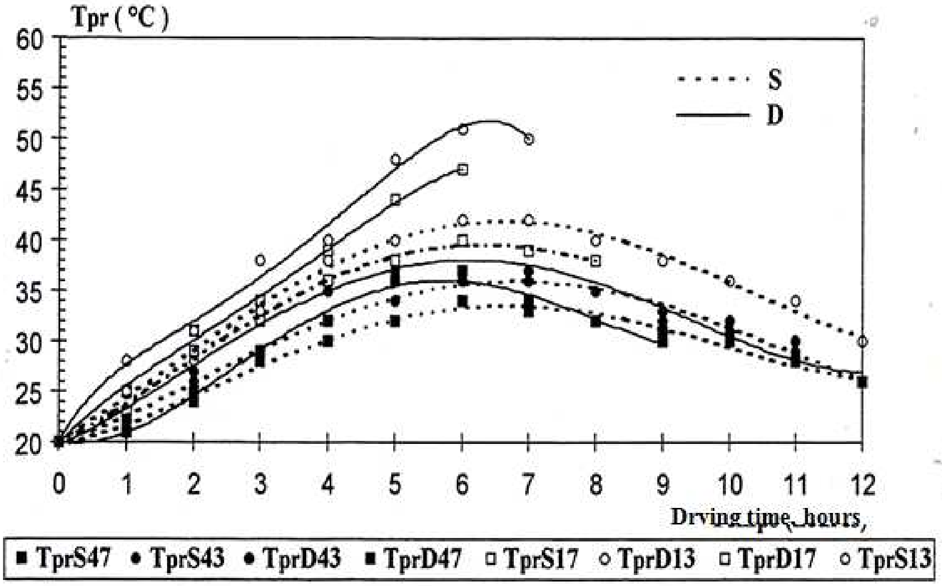

Figure 8: Evolution of the Temperature of GINGER in Relation to Drying Time Measured at the First and Fourth Trays with Flows of 31.3m³/h.m² and 70m³/h.m² using WB, DCL1 and TL Type Solar Panels

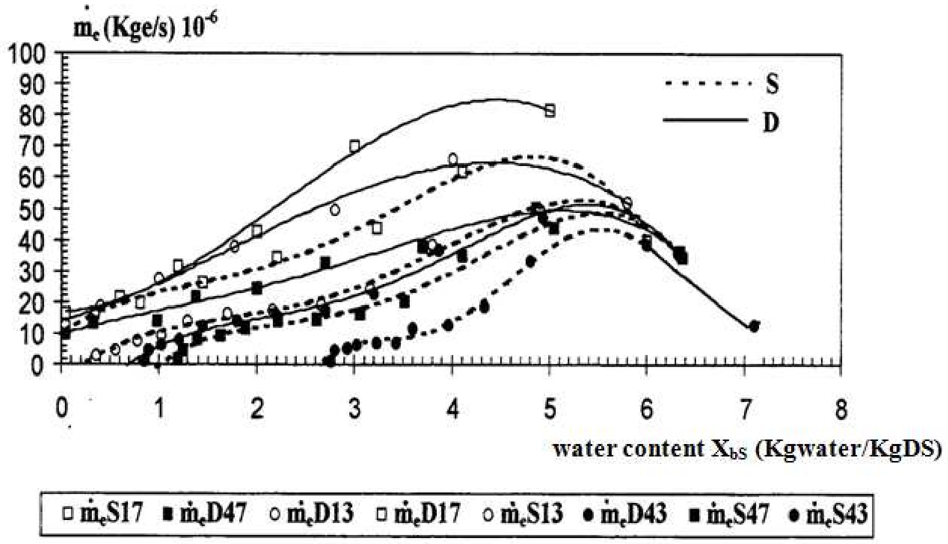

Figure 9: Evolution of the Drying Speed (m_e) in Relation to Water Content to the Point When the Product is Completely Dried with Flows of 31.3m³/h.m² and 70m³/h.m² using WB and DCL1 Type Solar Panels

Analysis of the findings relative to the WB solar panel (without baffles), reveals that functioning with a low air flow is considerably more efficient because of the reduction in drying time. The mechanical power consumed (P_{mc}) by the ventilator is proportional to charge losses and to the air flow in the dynamic air vein of the panel. This same power is expressed by:

$$P_{mc} = \Delta P.Q_V = \zeta.Q_V^3 \tag{5}$$

where ζ is the factor of friction, characteristic of artificial rough places (baffles)

As the relationship between the two flows is 2.24, the power is therefore increased by a factor of 11.24, a fact which further highlights preference for using a low flow. In spite of the recommendations made by some research workers not to exceed a drying air temperature of 55°C, higher temperatures were used in our experiments However, at temperatures above 70°C, reddening spots (*i.e.* signs of burning) appeared on the products. Indeed, the quality, subjected to conditioning by the thermal process. Consequently, to create ideal drying conditions at temperatures lower than those recommended for the product in question, some precautions.

Install A Thermometer at the entrance to the "drying cabinet" and use a higher air Debi if necessary to reduce the temperature while keeping in mind that if the increase in airflow become imperative install a temperature regulator adjusted to provide a constant drying air temperature of 55°C.

The quantities of heat available for use and reclaimed at the solar panel outlet are much higher when using solar panels equipped with TL baffles than those with DCL1 baffles. Variations in those quantities (Q_u), in global quantities of drying heat (Q_s) and their differences ($\Delta Q = Q_u - Q_s$) are shown in Figure. 10 (for WB solar panels without baffles) and Figure. 11 (solar panels equipped with DCL1 bafflesvariable). Worthy of note is the fact that the quantities of heat available for use are increased by a factor of approximately 1.65 as regards the performance of the SC solar panel. The differences in quantities (ΔQ) are of some consequence because they are, in fact, surplus to normal requirements for the drying process and can therefore be stored and made available for use, for example, during the night or on days when sunlight is mediocre [22, 23, 24, 25]. This excess of heating needs can be kept in underground ducts and thus ready for use when needed.

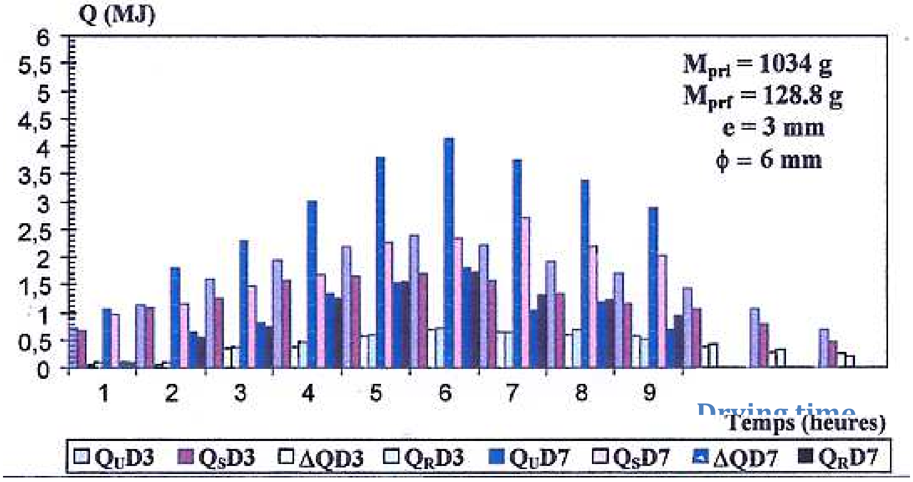

Figure 10: Variations in Quantities of Heat (Q) in Relation to Drying Time with Flows of 31.3m^3/h.m^2 and 70m^3/h.m^2 using an WB Type Solar Panel (without baffles)

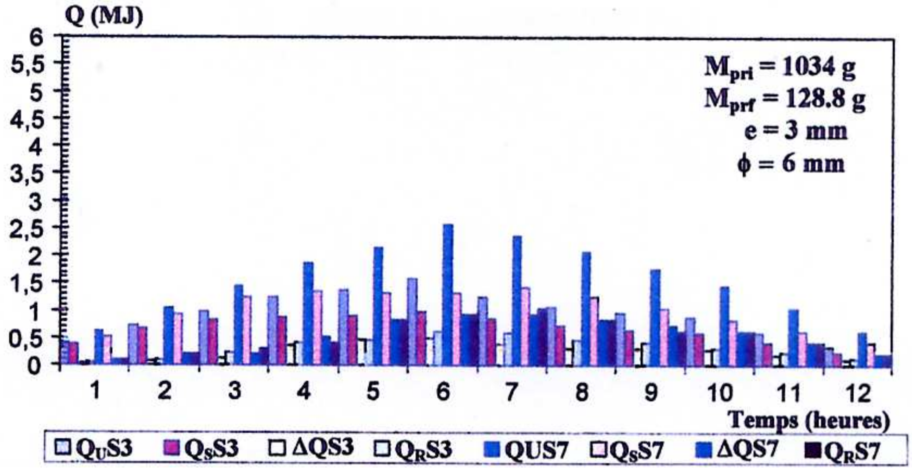

Figure 11: Variations in Quantities of Heat (Q) in Relation to Drying Time with Flows of 31.3m^3/h.m^2 and 70m^3/h.m^2 using a Solar Panel Equipped with DCL1 Baffles

CONCLUSIONS

The results of our experiments with different types of solar panels has variable chicane, the establishment of baffles in the air stream is a very important factor that serves the development of vortex bursting to improve the performance of a solar panel. Several Factors taken into account to understand the shapes and dimensions of the baffles, the number of lines and their layout. The study showed that a solar panel equipped with baffles not only significantly improves the relationship between temperature and thermal efficiency, but also reduces the drying time of medicinal plants (ginger). Also noteworthy is the fact that cross-cut (and) and (El) longitudinal spaces greatly contributes to the quality of results. In addition, an increase of the angle (dI) provides even better results. However, certain constraints imposed by the nature of the finished product, such as quality, flavor, color and nutritional value, should be taken into account in determining what constitutes the ideal temperature drying plant air.drying by solar panel medecinal variable baffle the result and retain the quality of the fiber after drying.It can be used to fight against infections, fatigue, muscle aches and digestive problems especially (vomiting, diarrhea...). Ginger also has aphrodisiac properties, antioxidant and antibacterial.

REFERENCES

1. Zugary M.R., Vullierne J.J., "*Amélioration des performances thermiques d'un capteur solaire par l'utilisation d'une structure à lamelles*", Entropie,n°176,(1993), pp25-30.
2. Ouard S., "*Optimisation des formes et disposition d'obstacles dans la veine mobile du fluide des capteurs solaires plans à deux couches d'air en vue de la maximisation du couple rendement et température*", thèse doctorat, Valenciennes, (1989).
3. Moummi N., "*Prévisions systématiques et optimisation des performances des capteurs solaires plans à air dans divers sites de climats Méditerranéens ou sahariens et avec ou sans altitudes*", thèse doctorat, Valenciennes, (1994).
4. Ben Slama R., "*Contribution à l'étude et au développement de pompes et capteurs solaires*", thèse doctorat, Valenciennes, (1987).
5. Choudhury C., Gary H.P., *Performance of air heating collectors with packed airflow passage*", Solar Energy, V 50,3, (1993), pp 205-221.
6. Gbaha P., "*Etude et optimisation des échanges thermiques et des performances des capteurs solaires plans à deux veines d'air*", thèse doct, Valenciennes, (1989).
7. Hachemi A., "*Contribution à l'optimisation des performances thermiques des insolateurs plans à air à lit garni de rangées d'obstacles aux pas serrés, amélioration du rendement par interaction entre rayonnement et convection*", thèse doctorat, Valenciennes (1992).
8. Moummi A., "*Etude globale et locale du rôle de la géométrie dans l'optimisation des capteurs solaires plans à air*", thèse doctorat, Valenciennes, (1994).
9. Météo France, Direction Régionale, Villeneuve d'Ascq, Lille, (2002).
10. Ahmed-Zaid A., "*Optimisation des capteurs solaires plans à air. Application au séchage de produits agricoles et de la pêche*", thèse doctorat, (1998)
11. Messaoudi H., Ahmed-Zaid, Le Ray M. "*Le rôle de la géométrie dans l'amélioration ou la diminution des échanges thermiques turbulents dans les capteurs solaires à air*", 3ème congrès de mécanique, Société Marocaine des Sciences Mécaniques et de l'université Abdelmalek Essaadi, Faculté Science de Tétouan, VI,(22-25 avril 97),pp637-644.
12. Ahmed-Zaid A., Messaoudi H., Benoyounes R., Le Ray M, "*Etude expérimentale de l'effet des chicanes sur les capteurs solaires plans à air, par simulation de l'énergie solaire*", 3èmes Journées Maghrébines sur la Mécanique, Institut de Mécanique, Guelma (Algérie), VI, (29-30 avril 1997), pp 212-218.
13. Le Ray M., Deroyon J.P., Deroyon M.J., Minair C., " *Critères angulaires de stabilité d'un tourbillon hélicoïdal ou d'un couple de tourbillons rectilignes, rôle des Angles Privilégiés dans l'optimisation des ailes, voiles, coques des*

avions et navires", Communication à l'Association Technique Maritime et Aérodynamique, Bulletin de l'ATMA, Paris, (avril 1985), pp 511-529.

14. Messaoudi H.,"*Structures tourbillonnaires induites par des obstacles triangulaires complexes et interactions ailes delta minces-corps de révolution. Application des Angles Privilégiés, en Aérodynamique et Energétique*", thèse doct, Valenciennes, (1996).
15. Abene A., "*Etude systématique des positions et de la stabilité des structures tourbillonnaires au-dessus d'ailes ogivales et de cônes*", thèse doctorat, Valenciennes, (1990).
16. Letz T., "*Modélisation et dimensionnement économique d'un système de chauffage domestique biénergie*", thèse doct, INSA Lyon, (1985).
17. Lewis W.K., "*The rate of drying of solid materials*", Journal of. Ind and Eng. Chem, Vol 13, 5, (1921), pp 427-432.
18. Sherwood T.K., "*The drying of solid*", V 21, 10, (1929), pp 12-16.
19. Kondé G., "*Résolution des équations de Luikov appliquée au séchage de l'oignon en vu de la réalisation de séchoirs solaires dans les pays sahéliens*", thèse doct, Perpignan,(1983).
20. Pasumarthi N., Sherif S.A., "*Experimental and theoritical performance of a demonstration solar chimney model-part II : Experimental and theorical results & economic analysis*", Internat Journal Of Energy Research, 22, (1998), pp 443-461;
21. Desmons J.Y., "*Formulation et résolution numérique des problèmes aux limites appliquées, aux générateurs de chaleur tubulaires enterrés*", thèse doctorat, Valenciennes, (1984).
22. Benyounes R., "*Prévision numérique et expérimentale de la réponse intrinsèque d'un échangeur bitubulaire enterré en régime continu*", thèse doctorat, Valenciennes, (1993).
23. Portales B., "*Etude et expérimentation du chauffage solaire des serres à stockage thermique souterrain*", thèse doctorat, Valenciennes, (1984).
24. N'Dongo M.M., "*Etude théorique d'un générateur solaire à air chaud constitué d'une serre agricole et d'un stockage de chaleur en sous-sol à l'aide de conduits. Application au séchage*", thèse doctorat, Clermont-Ferrand II. Blaise Pascal, (1989).
25. Dubois V., " *Etude détaillée des structures tourbillonnaires développées à l'extrados de corps élancés simples, complexes et de corps de révolution.* ", thèse doctorat, Valenciennes, (2005).
26. Abene A., Dubois V., Michel Le Ray M., A. Ouagued A., *"Study of a solar air flat plate collector: use of obstacles and application for the drying of grape"*, Journal of food engineering 65, (2004).
27. Abene A., Dubois V., Michel Le Ray M., Ouagued A., *« Etude expérimentale des performances thermiques de diverses configurations de chicanes placées dans la veine d'écoulement »*, Les Technologies Avancées n°16, Alger, (2003).

28. Abene A., Dubois V., Michel Le Ray M., Si-Youcef M., Ouagued A., *« Etude expérimentale de capteurs solaires à air : le séchage de la figue »* Les Technologies Avancées n°17, Alger, (2005).
29. **Abene A., Dubois V** « A experimental study of air heating plane solar panels as used in drying mangoes », International Journal of Energy Research, ref ER-09-1016, juin 2009,
30. **Abene A.** Study by Visualization of Vortex Structures were Warhead Wing, Apex angle ß 68.6 °. J Aeronaut Aerospace engineering 4.1 2015 ref: 2168_9792,100001378.
31. **Abene A, Mezache N, Rahmani A;** "An Experimental Study of the Mushroom drying by Solar Panels", impact: international Journal of Research in Engineering & Technology, Vol, 3Issue 12, December 2015.
32. **Abene A.** The Study by Visualization by smoke of Vortex Structures on the upper surface of an aircraft fuselage. Journal of Engineering Aeronaut Science & Research Technology, Decembre 14, 2015
33. **Abene A.** "Visualisation of Vortex Structures Developed on the Upper Surface of Double-Delta Wings", J Aeronaut Aerospace Eng 2:118, doi: 10.4172/2168-9792.1000118. Septembre 2013.
34. **Abene A.** "Experimental Study by visualisation of behavioural properties of vortex structures on the upper surface of an ogive of revolution ß 52° ", International Journal of Mechanical Engineering and Applications, Vol 2, n°5, pp 70-77, November 2014.
35. "**Abene A.** An Experimental Study of the Drying of Papayes by Solar Panels", J. Sustainable development Studies, Vol, 7, n°1, pp 84-108, November 2014.
36. **Abene A.** An vortex structures on the upper surface of a pointed gothic wing observed at low,median and high incidences -journal of vortex science and technology,ISSN 2090-8369 volume2-1, janvier 2015.
37. Regulation (EU) No 432/2012 of the Commission of 16 May 2012 establishing a list of permitted health claims on foods, other than those referring to the reduction of disease risk and the development and child health.

Nomenclature

A_C: surface activates plane solar collector [m^2]

b: width of the baffles at the base

b': coefficient of blocking

C_p: heat capacity of the air [J/Kg.K]

d: outdistance between the absorber and the cover or the insulator

$E\ell$: longitudinal space between lines of baffles

Et: space transverse between two baffles of the same line

h: initial height of the baffles

h_1: swing-over bed of the baffles compared to the insulator

h_{ccf}: coefficient of convectif heat exchange enters the air and the absorber [W/K.m^2]

I_{GS}: total time solar flow of simulation [W/m^2]

K_a, K_{IS}: thermal conductivity of the absorber and the insulator [W/m.K]

L: longitude of the place [degrees]

Z: altitude of place [km]

□: width of the vein [m]

m_e: speed of drying [Kg/s]

N_{Cr}, N_r: a number of baffles per line and a number of lines

Pmc: consumed mechanical power of the ventilator [W]

Po, P(Z): pressure atm on the sea level (10.13 105 Pa) and with altitude Z of place [Pa]

Q_{Va}: volume throughput of the air in the sensor [m^3/h]

Q_V: volume throughput of the air per unit of area [m^3/h.m^2]

Q_u: quantity of useful heat on the outlet side of sensor [MJ]

Q_S: quantity of heat of drying of product [MJ]

r: ray of bending of the baffles

Re: Reynolds number

S_{mini}: minimal bypass section of the air in the vein [m^2]

T_{SV}, T_a: temperature at the exit of the ventilator and the ambient air [°C]

T_e, T_{SC}: temperature of the air at the entry and the outlet side of the sensor [°C]

T_{Pr}: temperature on the level of the surface of the product [°C]

V_m: maximum speed of the air flow in the vein [m/s]

X_{bS}: water content at base dries of the product [Kg/KgMS]

X_{ObS}, X_{fbS} : water content initial and final at base dries [Kg/KgMS]

Greek Letters

α: Angle of inclination of the sensor compared to the ground [degrees]

β: Angle of apex (or at the top) of the baffles [degrees]

ε_c: Coefficient of emissivity of the cover

φ : Latitude of the place [degrees]

ν: Viscosity kinematic of the air[m^2/s]

ρ_0, ρ: Masse voluminal of the air on the sea level and altitude Z of the place [Kg/m^3]

η, η_t : Output of the plane solar collector and thermal efficiency of the system of drying [%]

τ_C : Coefficient of transmission of cover

ζ: Factor of friction characterizing artificial roughnesses (obstacles)

Δi: Angle of bending of the baffles [degrees]

ΔM: Loss of mass of the product [%]

ΔP: Pressure losses in the vein of sensor [Pa]

ΔQ :quantity heat excédentaire[MJ]

Notations

DCL1 : Forme of the baffles in the mobile vein of air: Delta and Curved Longitudinally with the flow attacking by point

OCL1 : Forme baffles in the mobile vein of air: Ogival Curved Longitudinally with the flow attacking by point

WB, TL : Without Baffles and Transversal-Longitudinal baffles

ηS : Rendement of sensor WB

ηD : Rendement of the sensor provided with baffles DCL1

ηTL : Rendement of the sensor provided with baffles TL

$X_{bS}TL13$: Tenor out of water at dry base in the case with the sensor provided with baffles TL, on the level of the 1st tray, using the flow of 31.3 $m^3/h.m^2$

$\Delta MD13$: Perte of mass of the product in the case of the sensor provided with baffles DCL1, on the level of the 1st tray, using the flow of 31.3 $m^3/h.m^2$

$T_{pr}S17$: Temperature of the product in the case of sensor WB, on the level of the 1st tray, using the flow of 70 $m^3/h.m^2$.

m_eD47: Speed of drying in the case of the sensor provided with baffles DCL1, on the level of the 4th tray, using the flow of 70 $m^3/h.m^2$

Q_uS3: Quantity of useful heat, in the case of sensor WB, using the flow of 31.3 $m^3/h.m^2$

Q_SD7: Quantity of heat of drying, in the case of the sensor provided with baffles DCL1, using the flow of 70 $m^3/h.m^2$.