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A new and economic way of using solar energy to dry materials

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PRECIS
Drying materials is energy intensive and well suited to using solar energy. This paper describes some experiments with using a porous fabric material as a transpired air solar collector to provide warm, dry air to dry wood chips.
It was found that collector efficiency was in the range of 70% to 80%. With a fuel price of about 6EUcents/kWh that gives a simple payback time of under 1 year in the least sunny country in Europe, Scotland.

INTRODUCTION

Drying is an energy intensive process, but energy is needed at low temperatures to accomplish it. Also, the energy does not need to be constant. Therefore it looks likely that solar energy is well suited for this purpose. This paper describes some experiments to use solar heated air, heated by passing air through a porous fabric exposed to the sun, to dry wet wood chips.

BACKGROUND

Using a porous material for solar heating of air is not new. Extensive work has been done in North America(2) to produce a perforated metal sheet(SOLARWALL) for this purpose and some experiments were done in Denmark(1) to use a fabric under to provide drying. However, the application for drying has not been extensively explored.

APPARATUS

The collector was simply a sheet of black fabric stretched over a wooden frame facing towards the sum. A fan was used to suck external ambient air through the fabric and transfer solar heat to the air. The warm, dry air was then delivered to perforated plastic pipes, commonly used for land drainage, located at the base of a pile of wet wood chips. The moisture content of the chips was measured at various stages of the process.

The fabric is a synthetic material commonly used for weed suppression and easily available at garden centres.
It is claimed to be UV resistant and estimated to have a life of at least 15years.

RESULTS

The collector was firstly tested for efficiency. It was found that collector efficiency was in the range of 70% to 80%.

The increase in air temperature across the collector was found to be approximately proportional to solar irradiance, with 30K corresponding to 1000W/m2. A characteristic of transpired air solar collectors is that efficiency is proportional to mass flow rate per unit area so this relationship should be maintained over a range of air flow rates.

The results of drying for a 1kg sample of wood chips with a collector area of 3m2 area was that moisture content was reduced from an initial value of 43% to 5% in under 48hours. This makes the chips much more useful and valuable since they become easier to store, transport and burn.

COST EFFECTIVENESS

The collector material was priced at under 5EU/m2 and it is estimated that it could be installed for under 10EU/m2

With a collector efficiency of 70%, an installed price of under 10EU/m2 and an effective fuel price of 6EUcents/kWH then the simple payback time in the least sunny country in Europe, Scotland, is less than a year. That must be a record.

OTHER APPLICATIONS

In addition to drying, such a collector could be used for other purposes:

1. Pre-heating air for air source heat pumps
2. Heating the ground for ground source heat pumps.
3. Pre-heating air for ventilation in buildings.

CONCLUSIONS

This is a very interesting application of solar heat and gives an economic return which must be a record.

References

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