

Solar Crop Drying Malabar, Indonesia



Roof mounted black SolarWall® System



Workers spreading tea leaves on drying troughs

Solar Tea Drying Solution

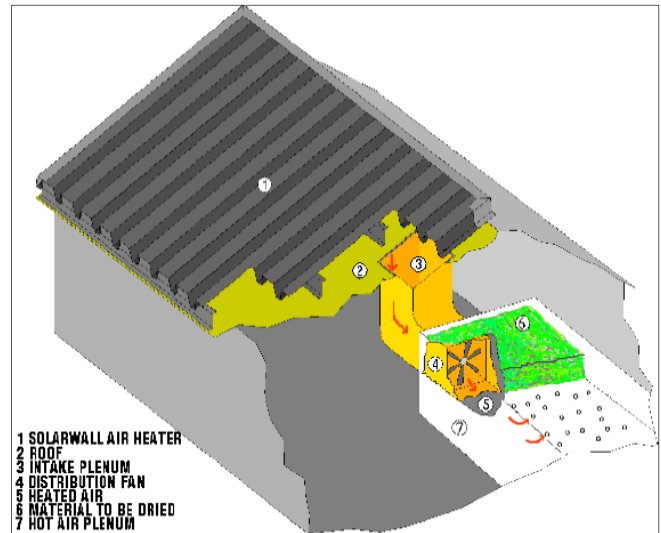
One of the most interesting solar applications is drying tea leaves. The leaves are dried at the wilting state where half of the moisture is removed.

A 6,500 ft² (600 m²) black aluminum SolarWall® system was mounted on the roof of the tea drying facility. Fans draw 75,000 cubic meters/hour of solar heated air into three drying troughs for drying the tea leaves. In the tea wilting process, the air temperature needs to be in the 35° C range which is ideal for the perforated, unglazed SolarWall® system. The three drying troughs each have a 1.5 ton capacity and utilize the existing 10kW fans. Temperature rise over ambient from the SolarWall® is approximately 10°C, delivering a temperature in the 35°C range.

Solar energy can be used to dry most crops and in processes requiring warm air. In fact, solar heat is often preferred since it does not burn or harm delicate foods, which often happens with steam or burning fuels. Solar heat is non-polluting and best of all, it is free!

Existing commercial drying operations can be converted to solar heat by installing a SolarWall® system on a nearby roof or wall and connecting them to the intake of the drier fans. All the air would pass through the solar panels where it is heated before entering the drying chamber. The existing burners can either be turned off or be used to top up the heat at night.

The system was monitored to evaluate its effectiveness and efficiency using a data logger. The results were very favorable (test results can be found on the next page) and according to the production manager there is an improvement in the quality of the dried tea.

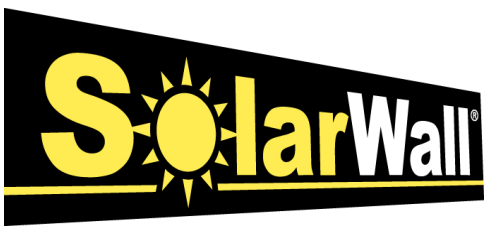


The above diagram shows the simple connection to the existing ductwork

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Conclusion

CIDA's results after testing the SolarWall® tea wilting system were:

1. The solar radiation available at this location is around 13.9MJ/m² day, in the solar system at Malabar 560m² the collector is used only for three troughs out of the 44 troughs used in the factory.
2. The utilization of the solar system is high enough (more then 264 days a year), which demonstrates the need for a wilting system is high
3. The average collector efficiency is around 61% (quite high). The temperature gain by the collector is around 30°C; it needs a large area of collectors to fulfill the wilting process
4. The duct efficiency is very good at around 87%
5. If wilting cost is considered, the solar wilter is cheaper compared with the existing system. The payback period is around 5 years.
6. The solar system is good enough to be used in the tea wilting process

Hourly Average Data of Solar Collection System in Malabar Tea Wilting Plant

Friday September 30, 1994

| Time | Relative Humidity Ambient % | Temperature Ambient °C | Solar Radiation W/m ² | Total Collector Average °C | Relative Humidity Dry In % | Q air Total m ³ /S | Collector Efficiency Average % |
|-------|-----------------------------|------------------------|----------------------------------|----------------------------|----------------------------|-------------------------------|--------------------------------|
| 8:00 | 77.6 | 11.1 | 282 | 12.7 | 59.2 | 0.0 | - |
| 9:00 | 77.0 | 17.8 | 545 | 23.7 | 56.4 | 0.0 | - |
| 10:00 | 76.8 | 18.9 | 745 | 31.2 | 55.4 | 17.0 | 63 |
| 11:00 | 76.9 | 18.5 | 700 | 31.2 | 52.5 | 20.4 | 83 |
| 12:00 | 77.2 | 18.2 | 611 | 29.4 | 53.1 | 19.7 | 81 |
| 13:00 | 77.0 | 16.8 | 347 | 26.1 | 54.0 | 14.6 | 88 |
| 14:00 | 76.7 | 16.8 | 145 | 22.0 | 55.0 | 11.8 | 94 |
| 15:00 | 76.9 | 16.7 | 108 | 20.2 | 55.8 | 12.5 | 91 |
| 16:00 | 77.2 | 15.9 | 95 | 19.4 | 56.1 | 11.0 | 92 |
| 17:00 | 76.8 | 15.5 | 75 | 18.1 | 56.9 | 10.8 | 85 |
| 18:00 | 76.8 | 14.6 | - | 14.8 | 59.1 | 0.0 | - |

Tuesday October 4, 1994

| Time | Relative Humidity Ambient % | Temperature Ambient °C | Solar Radiation W/m ² | Total Collector Average °C | Relative Humidity Dry In % | Q air Total m ³ /S | Collector Efficiency Average % |
|-------|-----------------------------|------------------------|----------------------------------|----------------------------|----------------------------|-------------------------------|--------------------------------|
| 8:00 | 78.2 | 10.6 | 127 | 9.8 | 58.1 | 0 | - |
| 9:00 | 77.3 | 11.0 | 48 | 13.6 | 55.4 | 20.2 | 34 |
| 10:00 | 77.3 | 15.6 | 762 | 23.4 | 55.3 | 21.1 | 48 |
| 11:00 | 76.7 | 21.3 | 960 | 32.7 | 54 | 22.3 | 59 |
| 12:00 | 76.5 | 24.2 | 1050 | 39.0 | 54.1 | 21.1 | 67 |
| 13:00 | 77 | 25.8 | 1005 | 42.6 | 53.8 | 20.4 | 77 |
| 14:00 | 76.7 | 26.3 | 895 | 42.8 | 53.6 | 15.8 | 65 |
| 15:00 | 76.9 | 24.4 | 728 | 37.2 | 53.9 | 22.3 | 88 |
| 16:00 | 77.2 | 21.9 | 495 | 21.6 | 54.5 | 20.2 | 89 |
| 17:00 | 76.8 | 19.0 | 152 | 23.3 | 53.3 | 20.2 | - |
| 18:00 | 76.8 | 16.6 | 17 | 16.5 | 56.3 | 0.0 | - |

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