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# Optical Efficiency and Selectivity Analysis of Lamp Black as Solar Selective Surface

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**Abstract**

This investigation has been directed towards the calculation of optical efficiency of spiral concentrating type solar cooker with lamp black as solar selective surface. Attempts were made to study the optical performance of the solar selective Coating. Spray painting technique has been adopted for coating the material. Aluminium and Stainless Steel Absorbers have been used and their optical efficiencies were compared with other black coatings. Water heating tests and indoor cooling efficiency. If has been concluded that the optical efficiency of the Spiral Concentrator has the maximum value with Aluminium absorber coated with lamp black.

**Keywords:** Selectivity, optical efficiency.

## 1. Introduction

Black solar absorbers are the chief component of concentrating type solar cookers. The Selectivity in defined an the ration of solar radiation (absorption) to thermal infrared radiation (emission) Typical value for a selective surface might be 0.90 solar absorptom and 0.10 thermal emissivity [1,3,4] The optical performance of an absorber depends on the optical constants and the thickness of the absorber coating. This selective surface was durable highly resistant to humidity, oxidizing atmosphere and less expensive [2].

## 2. Experimental

Ordinary lamp black is commercially available. It was spray painted over the Aluminium and stainless steel substrates. They were dried and used as absorbers. Water heating test was performed with the newly available absorber and it was compared with other commercially available black coatings.

Two pots one Aluminium and another stainless steel were used and the same lamp black was coated over the two absorbers. Water heating tests were performed individually to find the optical efficiency of the cooker with different absorbers..

To the tell whether the concentrator needs improvement it is important to evaluate the optical quality of the device. [5,7,8,9]

## 3. Result

The optical efficiency with the solar selective surface coating for Aluminium & S.S are fabulated

**Table 1.**Optical efficiency of Stainless Steel Absorber

| Temp Region °C | Mean Temp °C | Energ lost q loss watts | Energy used q gain watts | Input AcId | Optical Efficiency % |
|---|---|---|---|---|---|
| 30.5-38.2 | 5.35 | 10.331 | 269.07 | 618.73 | 45 |
| 38.2-45.2 | 12.7 | 25.9 | 344.18 | 627.7 | 43.03 |
| 45.2-52.8 | 20.05 | 40.96 | 368.5 | 633.5 | 48.88 |
| 52.9-60.2 | 27.55 | 56.29 | 254.85 | 635.5 | 48.92 |
| 60.2-67.1 | 34.85 | 70.80 | 240.69 | 637.6 | 48.8 |
| 71.8-77.9 | 45.85 | 83.85 | 212.79 | 635.6 | 48.2 |
| 84.3-87.9 | 57.1 | 116.87 | 125.58 | 619.9 | 39.07 |

**Table 2.** Optical efficiency of Aluminium absorber

| Temp Region °C | Mean Temp °C | Energy lost q loss watts | Energy used q gain watts | Input Acid | Optical efficiency |
|---|---|---|---|---|---|
| 35.8-44.1 | 10.5 | 16.83 | 287.2 | 812 | 49.64 |
| 44.1-53.7 | 18.4 | 29.49 | 332.2 | 619 | 38.38 |
| 59.4-66.5 | 32.46 | 50.70 | 359.2 | 620 | 49.3 |
| 66.5-72.3 | 40 | 64.79 | 207.6 | 618 | 44.08 |
| 72.5-78.2 | 45.85 | 72.59 | 197.2 | 623 | 43.2 |
| 78.2-84.3 | 31.75 | 76.54 | 211 | 612 | 46.9 |

From Table 1 & 2, it was found that solar selective coating of lamp black with Aluminum pot was more effective than S.S. Pot with lamp black coating. Because of the physical properties of stainless steel the optical efficiency is high, Moreover when lamp black in coated in different layers one over the other, the efficiency increases according to the thickness. The thickness of both Aluminium and Stainless steel pots with the thickness of the coatings decide the value of optical efficiency of the concentrator and overall efficiency of the cooker.

## 4. Conclusion

The water heating test and Indoor cooling tests were carried out in the calculation of optical efficiency of the solar selective surface [9]. The experimental results favour Aluminium with lamp black as solar selective surface because of durability, high tolerance to humid air and extreme temperature variation. It was able to retain the selective properties. [6]

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