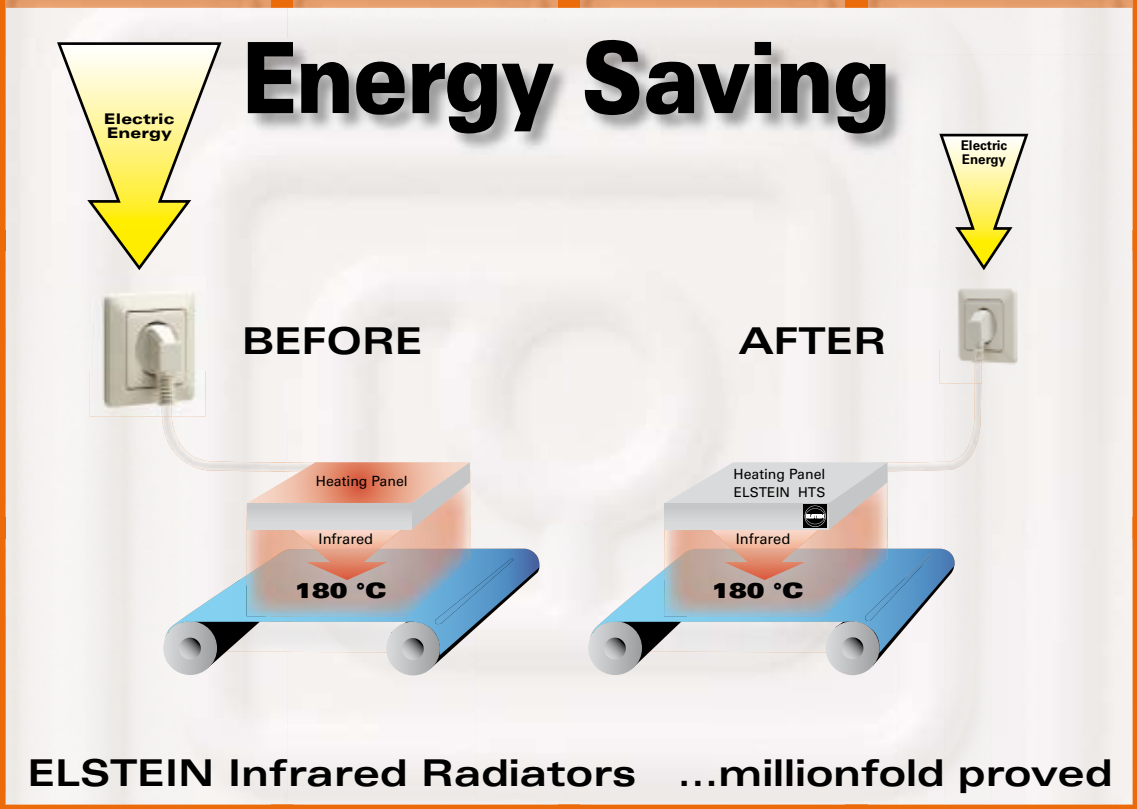


# Energy saving with HTS

# Energy saving potential of Elstein HTS-series

## 1. Task

The Elstein HTS series radiators are ceramic infrared radiators. Compared to full ceramic radiators the heaters of the HTS-series have an integrated thermal insulation material.

The task of this research was to determine whether radiators of Elstein HTS series have an energy saving potential compared to full ceramic radiators. Secondly the volume of energy saving should be determined.

## 2. Test setup

In order to determine the energy saving potential, water evaporation tests with 3 different infrared radiators were carried out. Figure 1 shows the test setup.


Figure 1: Test setup

A metal cup filled for each test with 100 g water was placed below an Elstein EBF/25 construction element. The temperature was measured at the middle on the bottom of the cup by using a thermocouple.

The Elstein EBF/25 construction element had a new and blank stainless steel reflector. The following test radiators were placed in this reflector:

a Elstein HTS/1 high temperature radiator 1000 W 230 V with integrated heat insulation

b Elstein FSR panel radiator 1000 W 230 V (full ceramic radiator)

c Infrared radiator from another manufacturer with FSR design 1000 W 230 V (full ceramic radiator)

At the beginning all test equipment parts were at a room temperature of 21 °C. In each test the radiators were turned on at the beginning of the tests. During the tests the electrical power was measured additonally to the measurement of the temperature of the metal cup.

The evaporation of water was used for proving the energy saving potential because it represents many drying processes for example in the food industry. However also production processes like thermoforming of plastic sheets correspond in many points to this test.

A further advantage of the evaporation test is that the end of the test can be determined easyly and exactly. When the water evaporated completely then the temperature of the metal cup increased relatively quickly and significantly above 100 °C.

## 3. Test results

Figure 2 shows the measured temperature curves of the three tests.

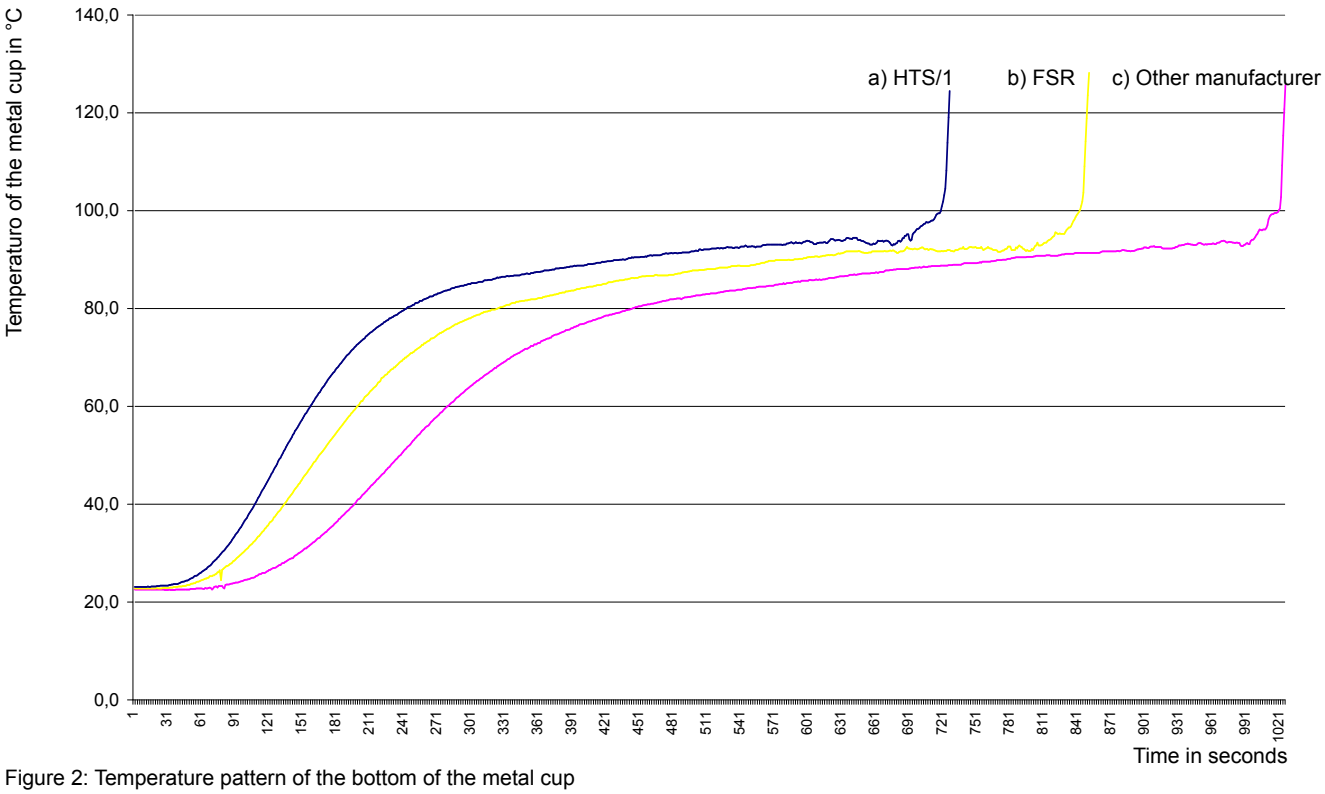


Figure 2: Temperature pattern of the bottom of the metal cup

The curves show a usual heat-up process. In the beginning the temperature increases strongly and remains some time within a small area below the evaporation temperature. After the water evaporated completely, the curves exceeded the 100 °C - line within a few seconds. For the evaluation the end of the test was set at the point where the curve reached 100 °C.

The following values resulted from the tests:

| Test | a | b | c |
|---|---|---|---|
| | HTS/1 | FSR | FSR (other manufacturer) |
| Power | 965 W | 976 W | 978 W |
| Evaporation time | 720 s | 844 s | 1021 s |
| Required energy (Power x Evaporation time) | 0,193 kWh | 0,229 kWh | 0,277 kWh |
| Energy saving related to c | approx. 30 % | approx. 21 % | - |
| Energy saving related to b | approx. 15 % | - | |

The test results show clearly the energy saving potential of Elstein HTS series compared to conventional full ceramic radiators.

However they enable further essential statements. For example if the cycle time of a heating task is significantly shorter, then the the energy saving potential improves further. This can be shown by using a simple example.

Assuming that the heating task is not to evaporate the water completely but to heat it up to 80 °C only. For this task HTS/1 needs approx. 240 s but FSR 320 s. In this case the energy saving is 25 %.

The results of these simple tests comply with results, which were determined in the field plastic thermoforming machines by customer in the year 1993 and being published in the magazine Kunststoff Journal. Also here an energy saving of 18 % to 20 % is reported.

The advantages of Elstein HTS series are not limited to energy saving only. Due to the lower masses to be heated shorter cycle times can be achieved, which leads in many cases to a significant increase of the machines output.

Since the radiators of the HTS series are significantly cooler on the back side compared to full ceramic radiators they hardly transfer radiation heat to the reflector. Due to this they are almost insensitive on changes of the reflector placed behind them compared to full ceramic radiators. Normally reflectors become dirty during operation or they oxidise on the surface. This leads to a significantly reduced reflection behaviour and the electrical power of the full ceramic radiator must be increased bit by bit.

A further collateral advantage of the improved efficiency on radiators of the HTS series compared to ceramic full radiators is the lower temperature in the wiring compartments. The lower temperatures give lower stress to the insulation materials of the wirings, which leads to a longer service life of the wirings.

The final statement is that the radiators of the HTS series provide many advantages to the user and that they are the state-of-the-art. For this reason new systems should be equipped in any case with these radiators. However, for many machines equipped with full ceramic heaters a replacement to radiators of Elstein HTS series is recommended if higher machine operation hours are reached.

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