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Dental Press, Ceramic and Sintering Furnaces: Efficient Energy Saving

Furnaces of the Programat® series from Ivoclar Vivadent help to save energy with various functions. While household appliances, for example, come with energy saving technology as standard equipment, dental press, ceramic and sintering furnaces are not normally equipped with this technology. Power saving technology not only benefits the environment, but also your wallet.

Recent investigations conducted by the „Interstaatliche Hochschule für Technik Buchs (NTB)", a Swiss university of applied sciences, prove the efficiency of power saving functions.

Topic: **Power Saving Technology: Efficiency due to low power consumption**

Title: **Description of the Programat power saving functions and their effects on energy consumption.**

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1. Objectives of the investigation

The energy saving options of Programat® furnaces were quantitatively investigated and qualitatively evaluated. The objective was the determination of the energy savings with regard to the following functions:

- **Reduced energy consumption in the stand-by mode**
- **Double valve vacuum technology**
- **Intelligent press function**
- **Fast sintering process**

The **reduced energy consumption in the stand-by mode** is an energy saving option implemented in the ceramic furnaces P300/G2, P500/G2 and P700/G2, as well as the press furnaces EP 3000/G2 and EP 5000/G2. Since the effect is the same in all furnaces, the investigation concentrated on the Programat P500/G2.

The **double valve vacuum technology** has exclusively been integrated into P700/G2. The difference in energy consumption between the furnaces was determined with the help of three representative firing programs that run on both P700/G2 and, as a reference, on P500/G2.

The **intelligent press function (IPF)** refers to the EP 500 furnace; it substantially reduces the processing time relative to a firing / pressing cycle without IPF. The resulting difference in energy consumption was measured.

The **fast sintering process** can be conducted with the Programat S1. In comparison with the predecessor furnace Sintramat, the sintering process in the S1 is considerably shorter. Also in this case, the resulting difference in energy consumption was measured.

2. Measuring procedure and set-up

To determine the energy consumption of an apparatus, i.e. the current furnace or the associated vacuum pump, the electrical power was directed to the furnace via a power meter and measured over a certain amount of time. Subsequently, the measured power was integrated to the converted energy. In a first step, the power meter mapped the transmitted power onto an electrical current, which was then measured with a ammeter. The measuring data were recorded in the target computer, saved and transmitted to the host computer (see Fig. 1)

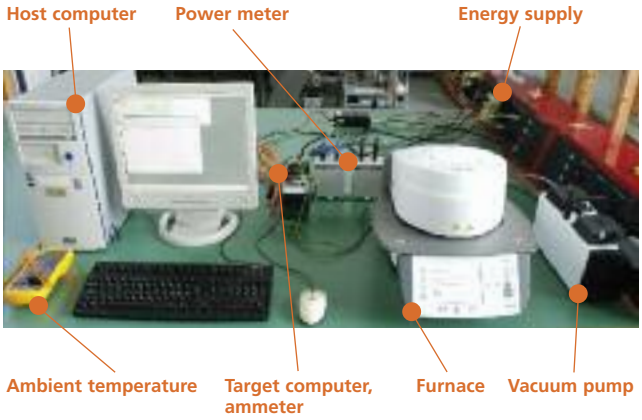


Fig. 1 Picture of the measuring set-up

3. Measuring results

3.1 Reduced energy consumption in the stand-by mode

The reduced energy consumption in the stand-by mode is an energy saving option that has been implemented in the furnaces of the "P" and "EP" series. Since the effect is the same in all furnaces, the investigation concentrated on Programat P500/G2.

P500/G2 was operated with a stand-by temperature of 403 °C. This temperature was kept constant during the test period so that the firing chamber and insulation were thoroughly heated. Hence, the furnace was in a thermally stationary state.

Two investigations were conducted with regard to the reduced energy consumption in the stand-by mode:

Investigation 1:
Stand-by mode of the P500/G2 for 80 minutes

Starting from the thermally stationary state, the "Power Saving" button was pressed, i.e. the furnace was switched to the power saving mode. The power saving mode lasted for one hour. After this hour, the furnace was returned to the stand-by mode by pressing ESC, i.e. the furnace again heated up to the stand-by temperature of 403 °C. It was assumed that the furnace was again thoroughly heated after 20 minutes.

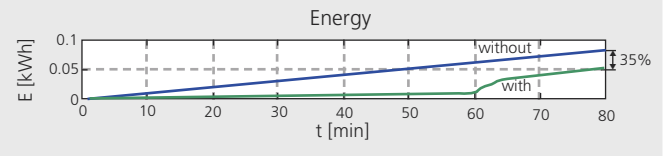
Investigation 2:
Stand-by mode of the P500/G2 for 196 minutes

Starting from the thermally stationary state (403 °C), the "Power Saving" button was pressed, i.e. the furnace was switched to the power saving mode. After that, it was waited until the furnace temperature decreased to the power saving temperature of 100 °C, which took 116 minutes. The furnace then ran in the power saving mode for another hour. After a total of (116+60=) 176 minutes, the furnace was returned to the stand-by mode by pressing ESC, i.e. the furnace again heated up to the stand-by temperature of 403 °C. It was assumed that the furnace was again thoroughly heated after 20 minutes.

Result:

Fig. 2 shows the measured curve of the energy consumption, each in the power saving mode (green) and without power saving mode (blue), as well as the resulting relative energy savings. In the first investigation, the saving amounted to 35% ($1 - E_{with} / E_{without} = 35\%$) and 57 % in the second investigation 57% ($1 - E_{with} / E_{without} = 57\%$).

Investigation 1:



Investigation 2:

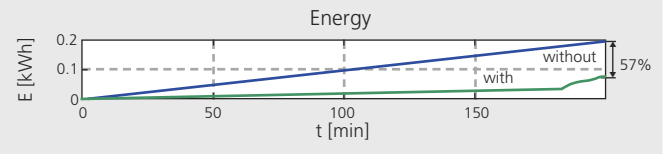


Fig. 2: Energy consumption in the stand-by mode - with and without energy saving function.

3.2 Double valve vacuum technology

The double valve vacuum technology has exclusively been included into P700/G2; it permits to switch off the connected vacuum pump once the desired pressure in the firing chamber has been reached. This reduces the noise exposure, wear of the vacuum pump, as well as the energy consumption of the pump.
The energy savings were determined by serially connecting a P500/G2 and a P700/G2 with same vacuum pump (VP 4). Each of these furnace/pump combinations was run with three representative Ivoclar Vivadent firing programs:

- Program 81: Crystallization / Glaze HT/LT
- Program 83: Fusion / Crystallization CAD-on
- Program 61: ZirLiner before wax-up and pressing

For each of these firing programs, the difference in the energy required by the P500/G2 + pump and P700/G2 + pump was calculated.

Result:
The results of the energy measurement showed the following relative energy savings:

- Program 81: 12%
- Program 83: 16%
- Program 61: 15%

3.3 Intelligent press function (IPF)

The intelligent press function (IPF) refers to the EP 500 furnace; it substantially reduces the processing time relative to a firing / pressing cycle without IPF. As can be seen in Fig. 3, a firing/press cycle with IPF takes 26 minutes, whereas a cycle without IPF takes 46 minutes. Therefore, the cycle with IPF took only 57% of the time of the cycle without IPF, i.e. 47% of the time was saved. The resulting difference in energy consumption was measured.

At the beginning of the investigation, a Programat EP 5000 was run with a stand-by temperature of 700 °C. This temperature was kept constant during the test period so that the firing chamber and insulation were thoroughly heated. Hence, the furnace was in a thermally stationary state. Simultaneously, a 300-gram press investment ring was heated to 850 °C. Here, too, it was waited until the stationary state had been reached. Then, the heated press investment ring was transferred from the pre-drying furnace to the press furnace, the furnace head was closed and the press program of the EP 5000 started after 20 seconds. The press program ran until the end.

Result:
Fig. 3 shows the measured curve of the energy consumption - with IPF (green) and without IPF (blue) - as well as the resulting relative energy savings, which amounted to 38%.

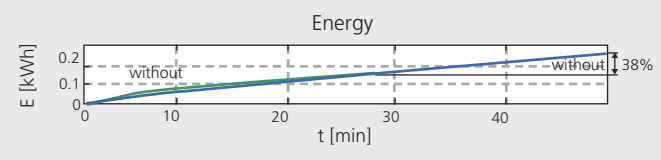


Fig. 3: Energy consumption curve with and without IPF.

3.4 Fast sintering process

The fast sintering process can be conducted with the Programat S1. The sintering process in the S1 is significantly shorter than the one in the predecessor model, the Sintramat. Also in this case, the resulting difference in energy consumption was measured.

The sintering programs of the two furnaces Programat S1 and Sintramat were started. They ran until the end of the respective program was reached.

Result:
Fig. 4 shows the measured curve of the energy consumption of the Programat S1 (green) and the Sintramat (blue), as well as the resulting relative energy savings, which amounted to 68%.

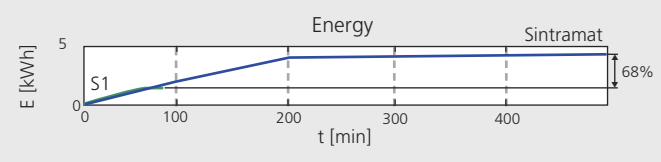


Fig. 4: Energy consumption during the sintering process

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4. Conclusion

These investigations confirm that the „Power Saving Technology“ really provides a potential to save energy. Particularly in the power saving mode, energy savings of 57% are excellent. The energy savings achieved with the Programat S1 can also be rated „excellent“. Up to 68% of energy can be saved with the fast sintering process. The double valve vacuum technology is less efficient with regard to energy savings. Depending on the selected program, up to 16% of energy can be saved with these functions.

Therefore, the „Power Saving Technology“ can be generally rated as a useful supplement for dental ceramic, press and sintering furnaces.

The new furnace generation: Efficient use of power and responsible use of valuable resources.

These products form part of our „All-Ceramics“ competence area.
All the products of this area are optimally coordinated with each other.

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