

Table 5 Energy consumption example of processes with/without preheating. Power consumption of laser unit is obtained from laser power at powder bed using formula 3.

Parameters	preheat free	preheat
Laser power at powder bed [W]	7.5	13
Power consumption of laser unit[W]	201	335
Scan speed [m/s]	1.5	3.78
Scan interval [μm]	30	150
Layer thickness [μm]	100	100
Irradiation time per volum [s/cm ³]	222	18
Energy consumption by laser per volum [kJ/cm ³]	45	6
Energy consumption by laser per mass [MJ/kg]	43	6

CONCLUSION

Plastic laser sintering using support structures instead of powder bed preheating was proposed. It was shown that a plate with thickness of 2mm can be obtained, and part density met standard level of normal preheating process, 90%. Investigation of applicability to larger or thicker object requires further research. Residual stress can be completely relieved by annealing treatment for agreeable duration. Tensile and impact strength were limited to 1/2 and 2/3 of those obtained by normal process, respectively. Clear reason for this degradation was not obtained. Energy consumption of laser module in preheating free process is around 45MJ/kg, and complete robustness against power supply interruption was demonstrated.

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