



Best Practice	TEMPERATURE AND TIMING CONTROL	INDH-02
Application	Process heating, industrial furnaces	
SME sector	Industrial	
SME Sub-sector	All	
Technical description	<p>Temperatures are measured at different spots, and control the fuel injection, and production speed.</p> <p>Different temperature levels can be necessary to achieve the required process, which can be melting, change of constitution, extraction of chemical compound, thermal treatment etc. Each process requires specific temperature conditions and processing time.</p> <p>In the case of batch process furnaces, preheating is necessary to bring the furnace to the right temperature. Often, the required time is over-estimated, and the furnaces spend stand-by time at the correct temperature but without the process running.</p>	
Recommendation for optimisation	<p>The following actions are the most common ones as they have the greatest energy reduction potential:</p> <ul style="list-style-type: none"> <li>• Furnace temperature should be monitored at different steps of the process, both in the heating media, and at the product directly</li> <li>• Predictive temperature control with PID systems can help adapting as precisely as possible the temperature to the process requirements</li> <li>• Optimised preheating time, general timing and control systems, help providing just what is needed from the heat and nothing more</li> </ul>	
Schemes and diagram	<p>The diagram illustrates a furnace temperature control system. It shows a furnace with a 'Crucible' inside, heated by a 'Heating Element'. 'material entrance' and 'material exit' points are indicated. The control system consists of two temperature measurement points, <math>T_1T</math> and <math>T_2T</math>, which feed into two control units, <math>T_1C</math> and <math>T_2C</math>. These control units manage the 'fuel' flow and a 'Control Valve' to regulate the furnace temperature.</p> <p>Furnace temperature control system</p>	



	In this case, T <sub>1</sub> C is the primary controller, T <sub>1</sub> T is the temperature of the exhaust material, T <sub>2</sub> T is the temperature of the furnace hearth, and T <sub>2</sub> C is the secondary controller. The output of the primary controller is given as a set-point to the secondary controller which controls the fuel flow. This type of loop and control system is crucial to reach an optimized temperature level in the furnace, and processing time.
Economics	Temperature control and regulation systems from approx. 300 EUR
Energy savings	5-10%
Economic savings	The economic savings can be traced back to the lower expenditure of energy resources. A lower consumption of electricity or fuel means a lower expense for the purchase of the same.
Average Payback Time	3-10 years
Emissions	Particulate Matter = 10 mg/Nm <sup>3</sup> NO <sub>x</sub> =350mg/Nm <sup>3</sup> Data referring to each Nm <sup>3</sup> of exhaust gasses
Environmental benefits	Reduction of CO <sub>2</sub> , NO <sub>x</sub> , and PM emissions
Main NEBs (Multiple benefits)	<input checked="" type="checkbox"/> Environmental benefits <input type="checkbox"/> Increased productivity <input type="checkbox"/> Work environment/ Health/Safety <input type="checkbox"/> Increased competitiveness <input type="checkbox"/> Maintenance
Replicability	High
Related measures	<ul style="list-style-type: none"> <li>• <b>INDH-01:</b> Optimization of the production system and distribution of heat</li> </ul>
References	ADEME, "La chaleur fatale" édition 2017 US DOE-EERE, Improving Process Heating System Performance – A Sourcebook for Industry



	Kumar, Y. P., Rajesh, A., Yugandhar, S., & Srikanth, V. (2013). Cascaded pid controller design for heating furnace temperature control. IOSR Journal of Electronics and Communication Engineering, 5(3), 76-83.
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