transfer coefficient of the thermal oil. This occurs because of the highest heat transfer resistance of the PCM, which dominates the transfer process.

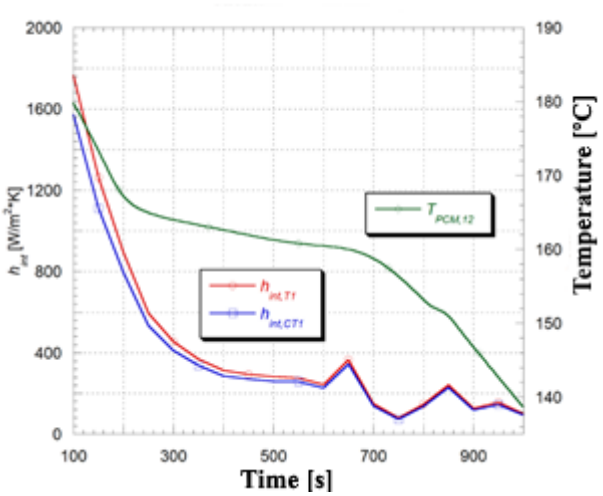

Fig. 9. Time evolution of the PCM heat transfer coefficient for a pump feeding frequency of 50 Hz, during the cooling process.

Table V shows average values for the overall heat transfer coefficient $\bar{U}$ and for the PCM heat transfer coefficient $\bar{h}_{int}$. The values referred by the term "correlation" refer to the values obtained using the external oil heat transfer coefficient, determined by the Zukauskas correlation, while the values referred by the term "experimental", were determined from the knowledge of the external heat transfer coefficient calculated by means of equation (6).

Table V. - Average values for the PCM heat transfer coefficient.

Process	Pipe	$\bar{U}$ [W/(m²K)]	$\overline{h_{int}}$ [W/(m²K)]	
			Correlation	Experimental
Heating 35 Hz	1	297	342	353
	2	466	550	546
	3	341	399	394
Cooling 35 Hz	1	357	432	480
	2	339	411	411
	3	361	440	434
Heating 50 Hz	1	354	406	412
	2	354	406	406
	3	398	464	458
Cooling 50 Hz	1	300	359	397
	2	289	345	345
	3	302	361	359

7. Conclusions

The performance of a PCM, a mannitol derivative with the commercial designation of Plus ICE A164, was analysed in a small test heat exchanger composed by a single layer of three horizontal pipes. Using an operating cycle composed by a heating and cooling process an average value of 350 W/(m² K), for the overall heat transfer coefficient, was determined. Subsequently an average heat transfer coefficient of 415 W/(m² K) for the PCM material was also determined. The time evolution of the PCM heat transfer coefficient is independent from the methodology used for the determination of the external heat transfer coefficient of the pipes containing the PCM.

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