AN ALGORITHM FOR OPTIMAL SELECTION OF THERMAL ENERGY STORAGE OPTIONS IN INDUSTRIAL WASTE HEAT RECOVERY APPLICATIONS

Giovanni Manente[1], Yulong Ding[1], Adriano Sciacovelli[1]

[1]*University ofUniversity of Birmingham, Birmingham, United Kingdom*

INTRODUCTION: The selection of the most suitable thermal energy storage in waste heat recovery applications is a challenging task. It involves several variables related to choice of the storage material and layout, which highly impact on the recovery from the heat source and the load operation and performance.

MATERIALS AND METHODS: An original algorithm is proposed in this work based on seven consecutive steps which lead to the selection of the best material and storage design for the given waste heat source and heat utilization/conversion system. The algorithm is first presented for sensible thermal energy storage and it is then generalized to address the best integration of latent heat and thermochemical energy storage. It consists of a preliminary design step to calculate the storage design, material and inventory and a simulation step to evaluate the transient response of the system in the charging and discharging processes. The functional parameters of the storage are selected to maximize the amount of waste heat recovered and not to degrade its quality. In the discharging the main outputs are the time variation of the temperature of the heat transfer fluid heated by the storage medium and the thermal power transferred to the load. If these values enable a proper and efficient operation of the load (e.g. domestic water heater, space heating, process heat for industrial processes, heat-to-power systems, heat upgrade systems, etc.), then the storage selection can be considered successful. The application of the algorithm is demonstrated for waste heat recovery from a discontinuous industrial process and utilization in a heat to power conversion system taking into account both consolidated and advanced storage options.

RESULTS: The results show how the electricity generated by the integrated system embedding the optimized storage design is highly improved compared to a more traditional choice. Moreover, the impact on the economics of the overall system is analysed.

CONCLUSION: The algorithm presented can therefore be used as an effective tool for choosing among thermal storage options in waste heat recovery applications.