Hybrydowe układy adsorpcyjne do redukcji emisji rtęci z zastosowaniem wysokoefektywnych komponentów polimerowych

Hybrid integrated adsorption system to reduce mercury emissions with the use of high-efficiency polymer components (HYBREM)

Project co-financed by the European Union within the priority axis "Support for R&D works by the enterprises" under the Operational programme: Smart Development, 2014-2020, Action 1.2 "Sectoral R&D programs".

Aim of the Project:

The aim of the HYBREM project is to develop innovative flue gas cleaning systems based on hybrid configuration consisting of several methods of mercury (Hg) reduction. Optimization of the developed system will finally allow to meet the new mercury emission limits for large combustion plants; it will also take into account the economic viability of the proposed solutions (investment and operational costs). The project is being implemented in the Consortium with the Pątnów II Power Plant, which is part of the Zespół Elektrowni Pątnów-Adamów-Konin SA [Pątnów-Adamów-Konin Power Plant Group Joint-stock Company].

The elements of the designed technology comprise both the commonly used mercury reduction techniques, including sorbent injection method and dosing of fuel additives, as well as innovative solutions based on polymeric membrane modules.

The project involves the construction of a pilot system, which will enable to obtain the data coming from the actual industrial processes. These data will form the basis of a numerical model that is currently being developed, which will be used to optimize the hybrid technology, as well as future industrial systems. This model will be implemented through Ansys Fluent commercial software with the application of User Defined Functions (UDF).

Planned Outcomes:

The proposed hybrid technology will be capable of reducing mercury emissions below the levels presented in the BAT (Best Available Technology) conclusions for large combustion facilities without the need to introduce significant changes to the conventional exhaust gas purification systems. The technology is an innovative solution, which in this configuration has not been used in the Polish and European energy sector. An additional benefit of the use of mercury adsorption agents is supporting the reduction of SO_2. The engineered solution is compatible with the technologies described in the BAT reference document for large combustion plants as a technology of removal mercury from flue gas (post-combustion).

Value of the Project: PLN 10,042,824.64
Contribution of European Funds: PLN 6,304,339.74

Pilot system

The integrated pilot plant (Figure 1) for the removal of mercury and SO_2 using polymeric modules will be built in on two power facilities. One of them is the Pątnów II Power Plant, a member of the Project Consortium. The system will be located in the exhaust gas draught; at the evacuation point of the existing scrubbers of wet FGD (Fig. 2) upstream the heat exchanger. The system will collect gases from the outlet of the horizontal reactor duct, and then it will direct the stream to the two collectors, in which the polymer modules will be placed arranged in series. The purified exhaust gases are then discharged into flue gas ducts, downstream the heat exchanger. The exhaust gas composition is monitored in particular in terms of the total amount of mercury in the gas phase and the concentration of SO_2 upstream and downstream the modules, but also periodically, at different points between the modules. The information obtained will form the basis for selection of the dimensions of the system in a full-scale, to reach different target values for exhaust emissions.

The introduction of the method of removing mercury using the polymer modules does not require significant interference in the unit diagram. It only consists in structural changes in the existing wet FGD systems. Moreover, the hydrophobic surface of modules has a catalysing effect on the conversion process of the sulphur oxide contained in the exhaust gas to SO_3, which then bind with water leading to the formation of sulphuric acid (VI). The resulting sulphuric acid is immediately neutralized in the absorber by applied lime water solution.

The polymer modules have a high capacity to adsorb atomic and oxidised mercury. They also have a large sorption capacity without the need for their regeneration, thanks to which they reduce the necessity to use expensive activated carbon that causes additional contamination.

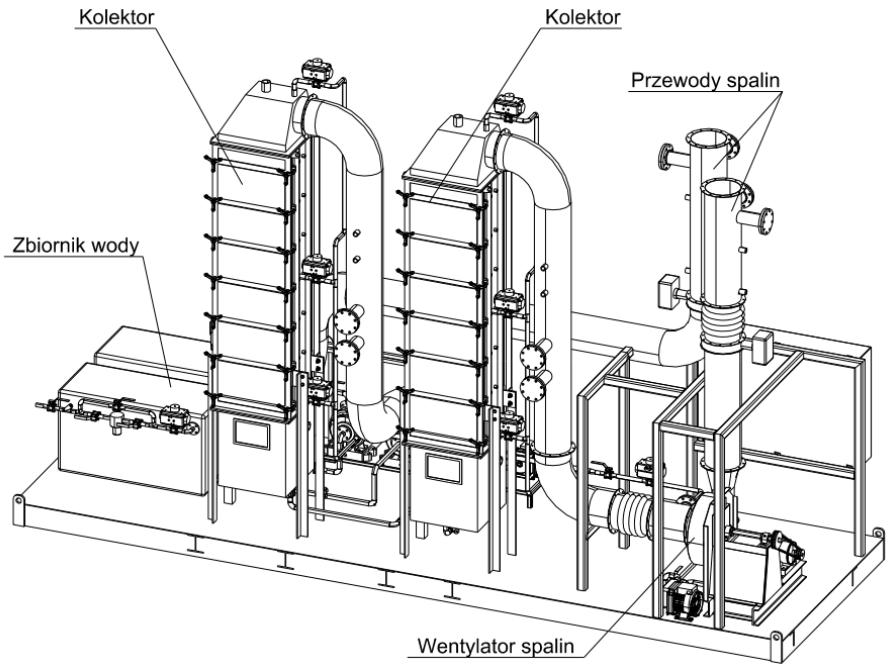

Figure 1. Illustrative sketch of a sample pilot system

Kolektor – Header / Zbiornik wody – Water tank / Przewody spalin – FG ducts / Wentylator spalin – FG fan

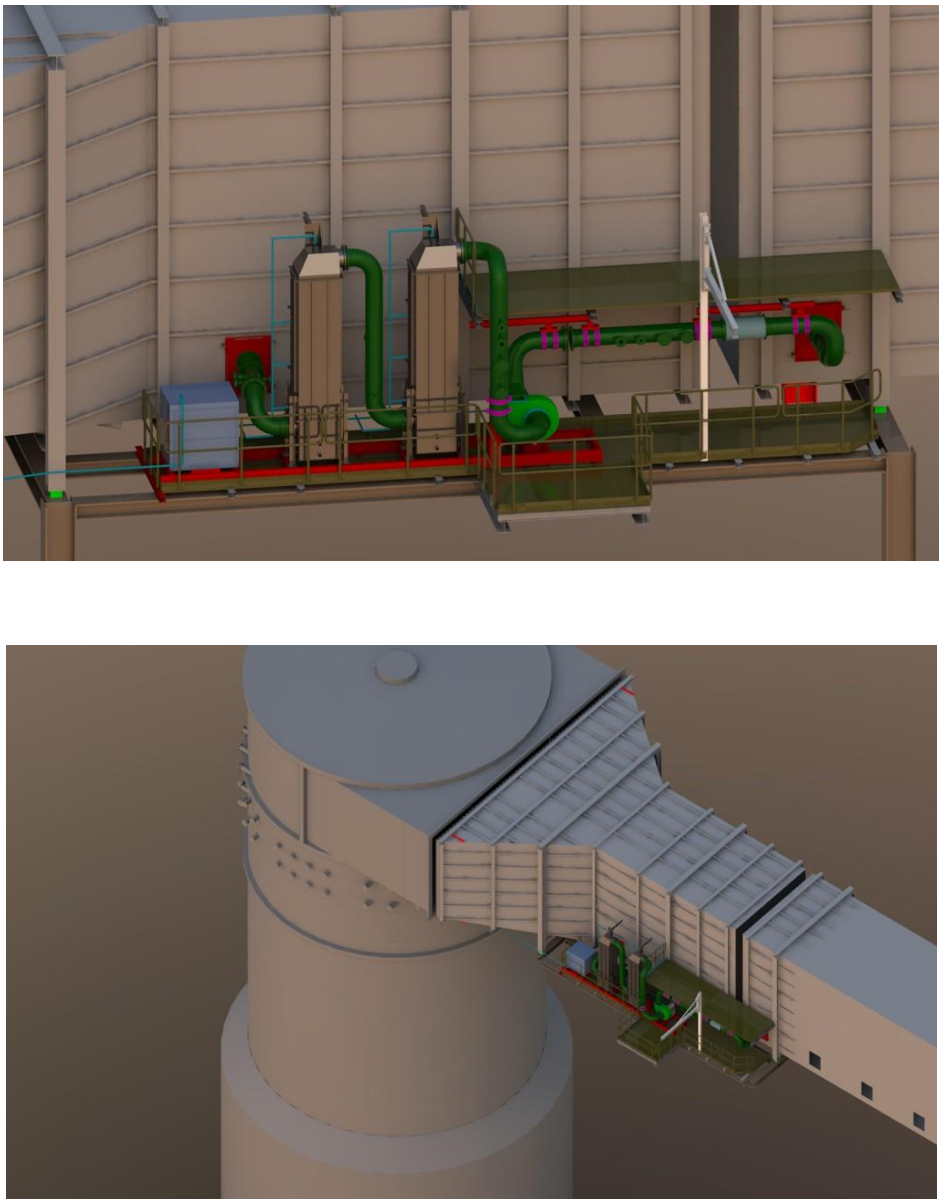

Figure 2. Visualization of the pilot system location at the outlet of the existing wet FGD scrubbers