Improving the FGD absorber and ESP performance at Iskenderun power plant

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Kurzfassung

Verbesserte Abscheideleistungen des Rauchgaswäschers und des E-Filters im Kraftwerk Iskenderun

Das Kraftwerk Iskenderun liegt im Süden der Türkei in der Bucht von Iskenderun in der Provinz Adana. Zwei Blöcke mit einer gesamten elektrischen Leistung von 1,210 MW werden durch ISKEN, einer Gesellschaft im Besitz von STEAG (51 %) und OYAK (49 %) betrieben. Der jährliche Brennstoffverbrauch beträgt rund 3,3 Millionen Tonnen SKE, wobei die Kohle aus Kolumbien und Südafrika importiert wird.

Zur Einhaltung der vorgeschriebenen Schwefel- und Feinstaub-Emissionsgrenzwerte mussten die Abscheideleistungen des Wäschers und des Elektrofilters verbessert werden.

In einem ersten Schritt wurde das Optimierungspotenzial des Wäschers und des Elektrofilters basierend auf dem Ist-Zustand (Referenzfall) mithilfe einer Strömungssimulation bestimmt. Sämtliche CFD-Berechnungen wurden mit der Software FLUENT 6.3 durchgeführt. Für die Erstellung der Geometrie und des Rechennetzes wurde das Programm Gambit 2.4 verwendet.

Die resultierenden Geschwindigkeits- und Konzentrationsverteilungen des Referenzfalls liefern ein tieferes Verständnis für die möglichen Verbesserungen.

In einem zweiten Schritt wurden mehrere mögliche Varianten mit verschiedenen Modifikationen an Komponenten analysiert und bewertet.

Im letzten Schritt wurde die Variante mit dem höchsten Verbesserungspotenzial ausgewählt und detailliert beschrieben.

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Isken Sugözü (Iskenderun) power plant

At the Isken Sugözü power plant 2 x 660 MW hard coal-fired boilers with two FGD scrubbers are operated. Each of the scrubbers is equipped with five levels of recirculation pumps with a flow capacity of 4.100 m^3/h. The flue gas mass flow is 1.9 million normal cubic meters per hour and the SO_2 load differs from 2,150 to 2,650 kg/h according to coal quality. In normal full load operation the FGD unit operates with 4 levels of pumps to keep the emissions below the legal limit of 400 mg/Nm^3.

Purpose of the project

The low SO_2 reduction efficiency of the existing scrubbers had to be improved to ensure that the current limit values and future sulphur dioxide emissions limits at the flue duct are met.

The modification was aiming at:

- Improvement of SO_2 emissions without changing the liquid/gas ratio. Increase of the number of nozzles for better distribution of the slurry.
- Meeting of the current SO_2 emission limit values with 3 recirculation pumps instead of 4 recirculation pumps by shutting down 1 pump (425 kW) to save energy.
- Increasing the SO_2 capture efficiency from 80 % to 90 % with 4 recirculation pumps.

The first study was started in 2008. A CFD modelling project was run by Steag Energy Services to improve the FGD scrubber performance. The flow of the flue gas into the scrubbers was monitored.

As shown in Figure 1, the study did not reveal major uneven flow inside the scrubber tank.

Before CFD modelling, compact deposits around the scrubber nozzles near the walls were detected (Figure 2). Most of these deposits were at the lowest nozzle level. This indicated to non-uniform profiles of velocity, suspension concentration, and temperature, which could also cause poor scrubber efficiency. Other influencing factors could be the position and flow rate of the nozzles, the upstream located guiding vanes, and the duct form.

In the CFD modelling process, the results of a theoretically homogeneous scrubber inlet profile did not show a significant improvement in terms of distribution of velocity, of suspension concentration as well as temperature profile. It became clear that whatever modification had to be implemented for achieving a homogenous inlet profile, it would not have any significant effect on the situation in the scrubber. This could be explained with the relatively high pressure drop caused by the injected suspension through the nozzles of 8.5 mbar. Therefore there was no need to take influence on the inlet velocity profile by modifying guiding vanes or other internals upstream in the flue gas duct.

The distribution profile in the scrubber was dominated by the implemented number, position and type of nozzles. CFD modelling figured out that overall suspension mass flow with double number of nozzles were reaching much more homogeneous velocity and suspension concentration profile.

As a result, it could be seen that the recirculation rate of the scrubber suspension is sufficient for the measured SO_2 content. Noticeable are the few nozzles per m^2 or in sum over all layers per m^2 with the consequence of a local more uneven l/g. Only when taking into account these facts it was recommended to increase the number of nozzles per layer by preserving the recirculation rate and change at the same time the type of nozzles to full cone nozzles with a spraying angle of 90° at the wall side and in the centre to hollow cone nozzles with a spraying angle of 120° which is state of the art. The full cone nozzles at the wall side are preventing that a great amount of the suspension almost immediately is hitting the wall of the scrubber and is lost for the desired deposition reaction. The 120° spraying angle of nozzles in the centre produce more droplet interactions and therefore a regeneration of the surface available for the reaction besides a more homogeneous injection in the flue gas flow.

After CFD modelling, one of the proposed modifications for the scrubber was increasing the nozzle quantity. Therefore, the design of the recirculation spraying headers had to be changed. Also, new type spraying nozzles had to be selected for better spraying quality according to the capacity of the pumps. Thus, the dimensions of headers