The 18th International Conference on Finite Elements in Flow Problems (FEF2015)
16-18 March 2015, Taipei, Taiwan

CFD ANALYSIS of WET FLUE GAS DESULPHURISATION WITH PERFORATED SIEVE TRAY

Chien-Chou Tseng*[,1], and Kuang-C Lin[1], Chieh-Sen Huang[2] E.

[1] Department of Mechanical and Electro-Mechanical Engineering,
National Sun Yat-sen University, Kaohsiung 30013, Taiwan
[2] Department of Applied Mathematics
National Sun Yat-sen University, Kaohsiung 30013, Taiwan
Corresponding author's email:tsengch@mail.nsysu.edu.tw

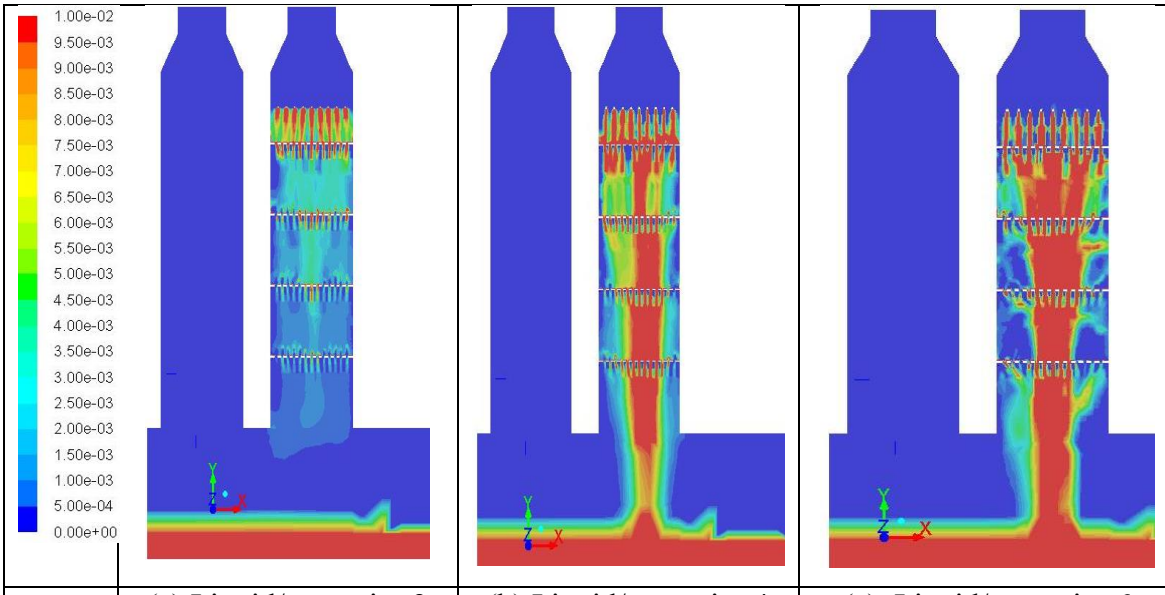
Key Words: *CFD, Flus gas desulphurisation, Sieve tray.*

During the industrial process in steel and power plant, sulfur dioxide is usually the major by-product within the exhaust gas. Therefore, the purification and removal of the toxic SO_2 component from the exhaust becomes a very important environmental issue nowadays. Chines Steel Corporation (CSC) has utilized a sieve tray tower to distil SO_2. The exhaust from the plant enters the bottom of the tower, and the pump applies pressure gradient to force the exhaust gas to the exit of tower at higher altitude. Then the liquid slurry is injected from the spray such that the chemical reaction between the exhaust gas and the slurry can remove the gas phase of SO_2 into slurry phase. In the current study, CSC also uses 3~4 perforated sieve tray to enhance the efficiency of the chemical reaction and the removal rate of SO_2. Our goal is to analyze the flow structures and the chemical reaction process within the sieve tray tower such that the further optimal design can be reached.

Our numerical framework, consisting of fluid flow and chemical reactions, is improved from ref. [1,2] and so on. The simulation is three-dimensional, and the representative results based on different liquid/gas ratio, said to be 2, 4, and 6, are presented in Figure 1 by liquid volume fraction and mass fraction of SO_2. The results indicate the higher liquid/gas ratio can improve the removal of SO_2. Besides, the comparisons between our CFD and experimental results are highlighted as shown in Table 1, showing a very good consistency regarding SO_2 removal rate. The optimal process, including pump coefficient, liquid/gas ratio, and the design of the perforated sieve tray, will be treated as the design variables for the further numerical experiment to improve the objective of removal rate of SO_2.

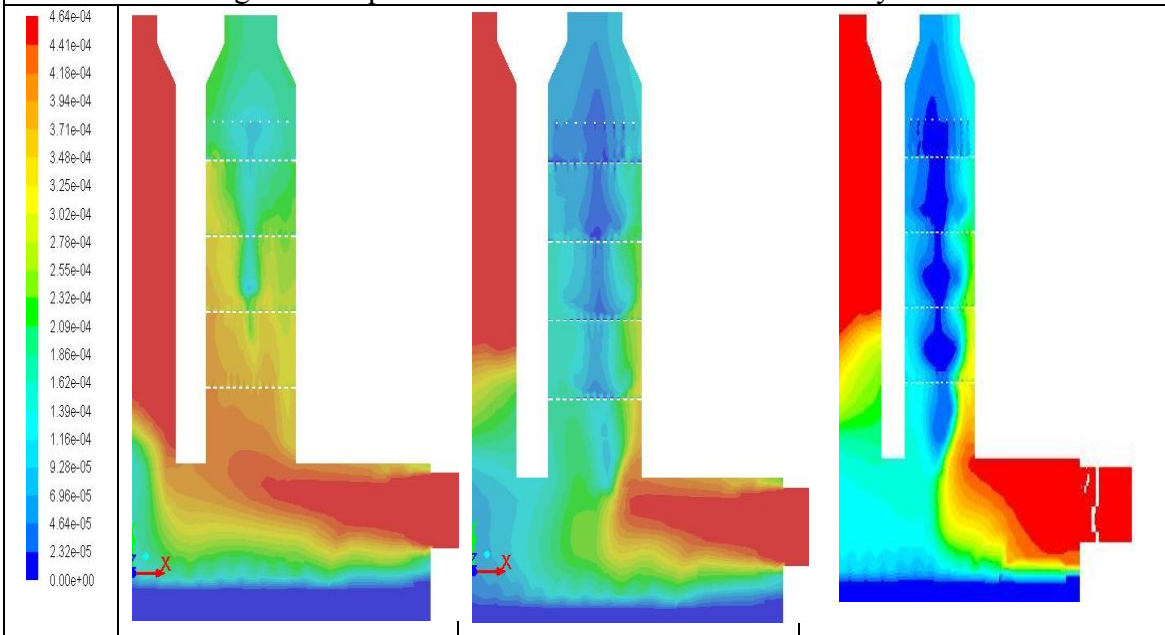
REFERENCES

[1] Luca Marocco, Fabio Inzoli .Multiphase Euler–Lagrange CFD simulation applied to Wet Flue Gas Desulphurisation technology. International Journal of Multiphase Flow 35 (2009) 185–194
[2] Fang Zeng, LianQing Yin and Li Chen. Numerical Simulation and Optimized Design of the Wet Flue Gas Desulphurization Spray Tower.



(a).Liquid/gas ratio=2 (b).Liquid/gas ratio=4 (c). Liquid/gas ratio=6

Figure 1. Liquid volume fraction inside the sieve tray tower



(a).Liquid/gas ratio=2 (b).Liquid/gas ratio=4 (c). Liquid/gas ratio=6

Figure 1. The concentration of SO_2 inside the sieve tray tower

Table 1. The comparsions between CFD and experimental results.

	GT3			GT4		
	Exp.	CFD	Error	Exp.	CFD	Error
Liquid/gas ratio=2	54%	47.3%	6.7	66%	59.0%	7
Liquid/gas ratio=4	49%	56.4%	7.4	68%	66.5%	1.5
Liquid/gas ratio=6	59%	69.0%	10	78%	76.4%	1.6