Modeling of pollution diffusion into air in rectangular area

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1. Introduction – theorical aspect in redistribution of mass, energy... constitute an essential tool in environmental analysis and support real observation study. The resolution of diffusion coupled with Navier-Stokes's equation is not an easy task if we follow the classic analytical method. Our goal is to develop a finite element program that can compute the diffusion of CO2 through air in rectangular geometry. Firstly, we have developed the corresponding finite element model of the two gases based on literatures [1-2]. Next, we have developed specific program using Matlab® to evaluate the behaviour of concentration distribution (stationary and non-stationary study). Good agreement of the obtained result with the existing in literature once are observed. Finally, the finite element program was associated with Genetic Algorithm optimization. This enable us to evaluate the best parameters of our study

2. Experimental –Matrix assembling is performed. Then RK method is used for non-stationary case and linear solving is used for steady-state problem .
The constitutive equations are given below:

$$\begin{bmatrix} [K_{D11}+K_{k1}] & -[K_{D12}-K_{k2}] \\ -[K_{D21}-K_{k1}] & [K_{D22}+K_{k2}] \end{bmatrix} \begin{Bmatrix} \{C_1\} \\ \{C_2\} \end{Bmatrix} = \begin{Bmatrix} \{j_{11}\} \\ \{j_{21}\} \end{Bmatrix} - \begin{Bmatrix} \{j_{12}\} \\ \{j_{22}\} \end{Bmatrix}$$

$$[K_N]\frac{\partial\{C_1\}}{\partial t} + [K_N]\{C_1\} + [K_{k2}]\{C_1\} - [K_{k1}]\{C_1\} = [N]j_1 n$$

$$[K_N]\frac{\partial\{C_2\}}{\partial t} - [K_{k2}]\{C_1\} + [K_{k1}]\{C_2\} = 0$$

3. Results and Discussion – As seen in the next figure, in the left gradient concentration of CO2 distribution in the stationary case is plotted and the right we have the behaviour of CO_2 distribution evolution in a time-dependent case.

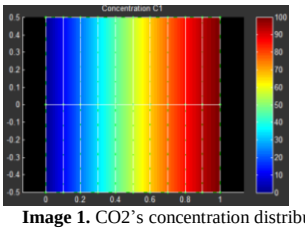

Image 1. CO2's concentration distribution (stationary)

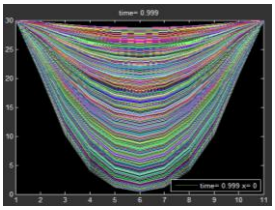

Image 2. CO2's concentration distribution (transient problem)

At the end, the constants of partial differential equation, named optimal material parameter was evaluated by the use of the association of finite element with genetic algortihm programs. After simulation, we obtained.

4. Conclusions

Development of finite element model is presented in this paper; to follow the behaviour of concentration's of bi-particle (O2 and CO2). Optimal material parameters are obtained by Genetic Algorithm program.

5. References

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