1. VENTILATION OF THREE–DIMENSIONALWELDING WORKSHOP WITH HOT OBSTRUCTION

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ABSTRACT

This study investigates numerically and experimentally the internal environmental conditions that prevail in a large-mechanically ventilated-welding workshop with dimensions of (17m x 12m x9m) for (length, widthand height) respectively. This study is accomplished by the computationalfluid dynamics (CFD) using the engineering program (ANSYS15). Theinternal space of the welding workshop was built and designed by the
(Design Modeler) program. The three dimensional flow was resolved by the (Fluent15) program within the (ANSYS15) program, which depend on using finite volume method (FVM) to solve the partial differential equations (PDEs) by converting these differential equations to algebraic equations. The governing equations being solved are continuity, momentum and energy equations. The flow of fluid inside the welding workshop is turbulent due to high Reynold's number, so the model equation used in the turbulent flow is (k-ε standard model equation). In addition to the above main equations, CO_2 and CO concentrations equations are also considered in this study.

The numerical results and experimental measurements are matched together, which show reasonable differences. Various schemes are implemented in the model to investigate the environmental conditions that prevail in the workshop under different ventilation. The numerical results and experimental measurements include airflow characteristics, such as air velocity, relative humidity and concentrations of CO_2 and CO gases at different locations of the internal space as well as the surface temperature of the internal materials in the welding workshop, when this workshop is empty and when it is preoccupied with welding operation processes.

Different cases are studied. In each case, the factors air change per hour (ACH) and containment removal effectiveness (CRE) are studied. In the present study, as a first step, the ANSYS 15 program was validated against a previous research]1[. For this purpose, the above program was used to design a room, similar to that considered in the previous compared with research work]1[. The thermal performance of this room comprising the distribution of temperature, velocity, and CO concentration inside the designed room are studied. All the results in this verification case were in agreement with the previous one. The studied cases are accomplished inside (welding workshop) in Basra Oil Training

Institute, these cases are: (empty- case, five of welding machines operated- case, six of exhaust fans are operated-case, full space case and two new redesigned suggested-cases).This study includes a real case, namely, which is studied when it is empty and reoccupied with a welding operation processes under different ventilation system conditions. Then this workshop is subjected to some changes including, different number of exhaust outlet fans, number of operated welding machines. From the results which are obtained, it is found that the ventilation system inside this welding workshop have some problems, so the main outcome stage is to study two redesigned-suggested for ventilation cases inside the welding workshop, in which the air change per hour (ACH) is controlled, and the emitted CO and CO gases disposed through a suggested system. It is found that when increasing (ACH) to (20), this will lead to decrease the concentrations of CO and $CO_2$to acceptable value and improve (CRE) to 3.12 for CO_2 and (CRE) for CO is 3.5.