

Modeling and assessment of Radioactive Iodine dispersion inside Egyptian Radioisotope Production Facility

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ABSTRACT

Indoor Air Quality (IAQ) is very important topic in any radioisotope production facility. It is mandatory for some operators to be available behind hot cell that produce radioisotope to practice some tasks concerning maintenance, dosimetry and operation. One of these tasks is redundant transferring Radioiodine from cell to quality control lab and vice versa for measurements. Contam3.2 is a simulation model from NIST (National Institute of Standards and Technology) is used to study and predict I131 concentration in air in hot cell and area of operator behind the cell in emergency case. Emergency is described by dropping small amount of I131 on cell floor..

1. INTRODUCTION

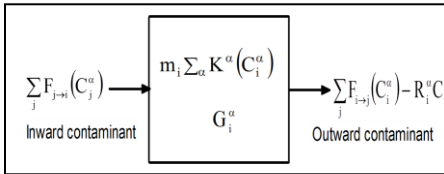
The objective from the manuscript is mainly to study the capability of ventilation system to govern and keep airborne contaminants inside the facility to be lower than concentrations facility in case of abnormal and severe conditions.

2. METHODOLOGY

CONTAM [2] is a powerful software that can simulate flow of air and contaminants dispersal in areas. This program employs mathematical equations to simulate flow of air and its contaminant which is related phenomenon and therefore considers assumptions that are necessary to make the model simpler to realize solution.

$$\frac{dm_i^\alpha}{dt} = \sum_j F_{j \rightarrow i} (C_j^\alpha) + G_i^\alpha + m_i \sum_\alpha K^\alpha (C_i^\alpha) - \sum_j F_{i \rightarrow j} (C_i^\alpha) - R_i^\alpha C_i^\alpha$$

$$S_\alpha(t) = G_\alpha - R_\alpha \cdot C_\alpha(t)$$



3. Results and discussions

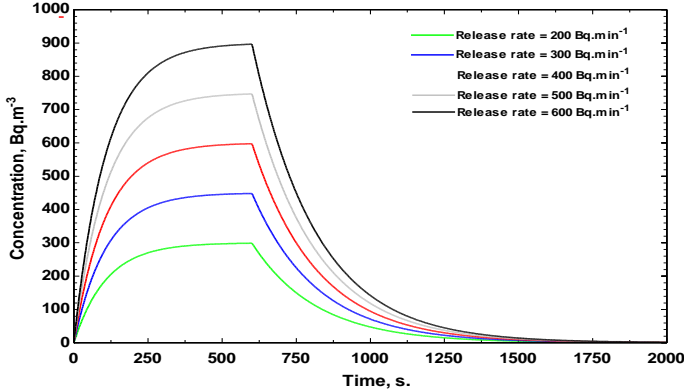


Fig. 3 Air concentration in Iodine hot cell

Table (1): Annual limits on intakes for workers exposed to radioactive iodine

Isotope	Oral (μCi)	Inhalation (μCi)	Inhalation (Bq)
I-129	5.4	8	3×10 ⁵
I-131	27	50	1.85×10 ⁶

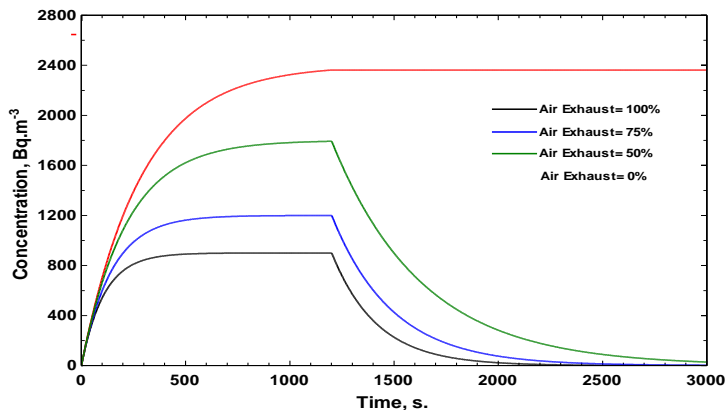


Fig. 4 Contaminant concentration in Iodine hot cell with different ventilated air

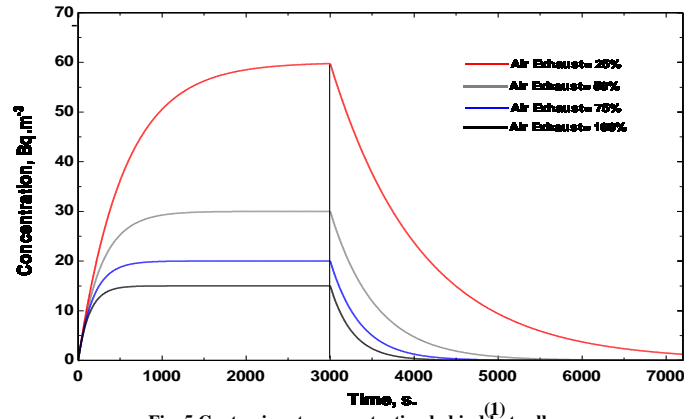


Fig. 5 Contaminants concentration behind hot cell

3. CELL OPEN DOOR EVENT

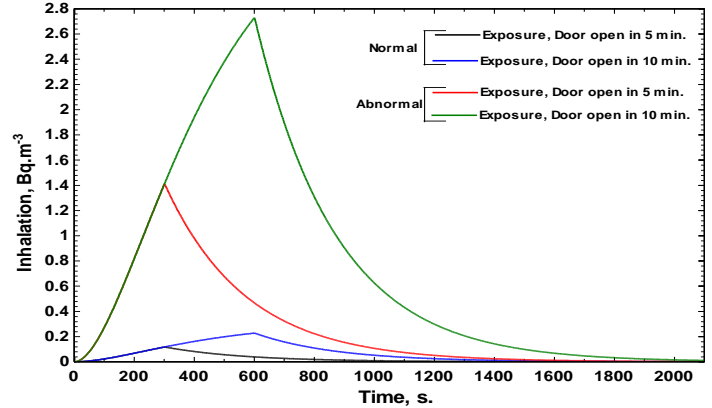


Fig. 6 Inhalation exposure in normal and emergency condition

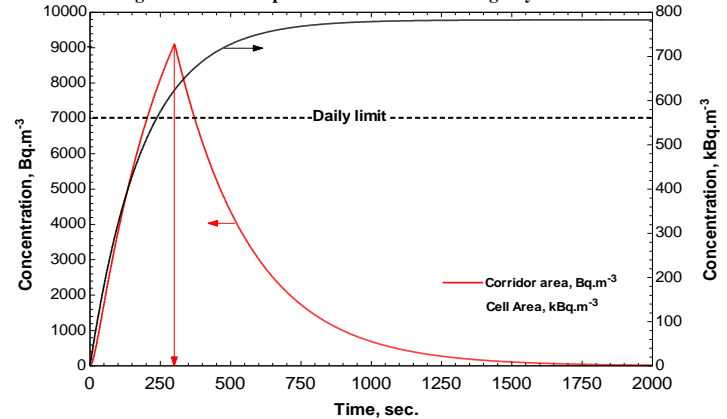


Fig. 7 Corridor and cell concentration in severe condition

CONCLUSION

Simulation model is formulated using Contam3.2 to predict release of radioiodine 131 contaminant in two areas during normal, abnormal and emergency situations. One is hot cell which process and produce isotope and the second is the back corridor of the cell to handle iodine radioisotope. Concentration of contaminant is predicted inside hot cell at different I-131 source rates and different exhaust air flow rate from the cell. The predicted results that ventilation exhaust system can satisfy the required protection by purifying all contaminant from I-131 and deposits it in the dedicated filters

REFERENCES

- Ralph Stuart, et al. "Assessing general ventilation effectiveness in the laboratory" Journal of Chemical Health and Safety Volume 22, Issue 2, Pages 2-7, 2015
- NIST Technical Note 1887 CONTAM User Guide and Program Documentation Version 3.2, 2015
- Public health assessment Iodine-131 Releases Oak Ridge Reservation (USDOE) Oak Ridge, Anderson County, Tennessee, March 2008
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