Radiotracer RTD Measurement of a Lab-scale Process Enhanced System Analysis

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1. Introduction

1.1: Background

Radiotracer residence time distribution (RTD) method is used for diagnosing and optimizing industrial processes and units. The principle [consists of a common impulse-response method (Equation 1) [1] [2] [3]

$$E(t) = C(t)/\int C(t) \quad \text{Equ.} \quad (1).$$

Where; E(t) is the RTD function, C(t) is the tracer concentration versus time at the outlet of the system.

1.2: Objective.

- **Main objective:** improving the analysis of the RTD data using different mixing numbers between the model and the designed mixing cells.
- **Specific objectives** :

a) Measuring the RTD of a lab scale continuous stirring tank.

b) Identifying the cause of possible malfunctions.

2. Materials and Methods

- Water flow rig
- ALTAIX data acquisition system
- A sharp pulse ^{99m}Tc radiotracer(1ml, 1mCi) was injected into the flow rig (flow rate 12LPM and tank volume 98.5L) using a shielded hypodermic syringe)and a detector marked time zero at the tank inlet . the passage of the tracer was recorded by the a second detector located the tank outlet Figure 1.

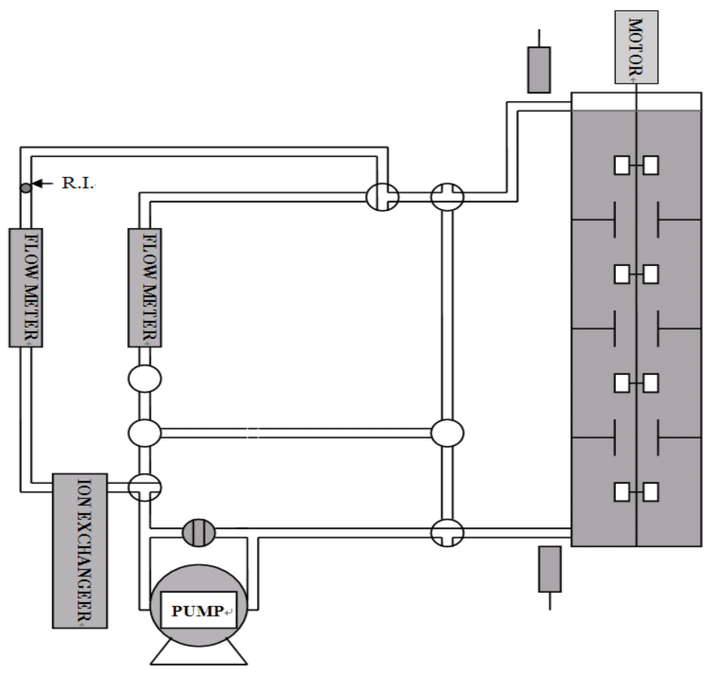

Fig.1:Schematic of flow rig

3. Results

The major findings are illustrated in figures 2 and 3.

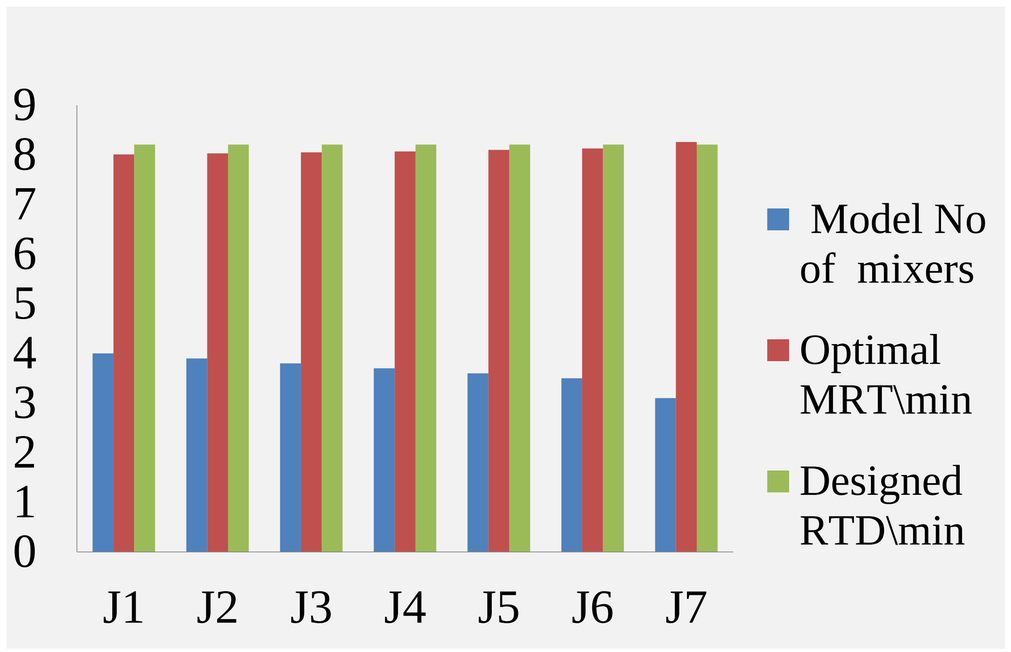

Fig.2:Optimal RTD for different mixing numbers

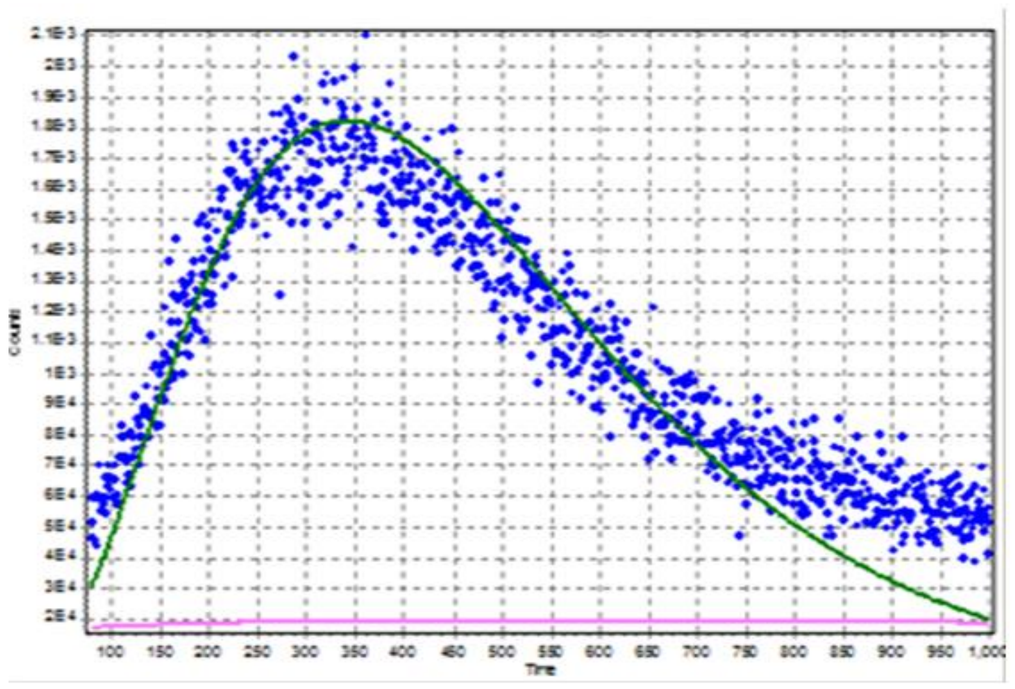

Fig.3: Model fit to Data using J3.

4. Conclusion

- For mixing numbers between model number(3.1) and the designed tank number(4) using perfect mixer in series model to simulate the data, the average tank number(3.55) gave the best MRT value (8.1 minute) with a satisfactory model fit to data.
- The RTD curve characteristics and the estimated tank effective volume assume the presence of normal flow.

5. References

[1] Radiotracer RTD method for Industrial and Environmental Processes, IAEA , 2008.

[2] Rachad Alami and Abdelsalam Benstile , Radioisotope Technology as Applied to Petrochemicals.(2012), INTECH

[3] laboratory experiments and modeling for industrial radiotracers applications, H. Kasban et al. ELSEVIER 2010