CHAPTER I

INTRODUCTION

Fluid mixing is the most universal of all processing operation in chemical process and allied industries. It is of vital importance in mixing food, petroleum, petrochemicals, chemicals, pulp and paper, phamaceuticals and in municipal and industrial waste treatment. Both heat and mass transfer are greatly influenced by mixing. In fact, mixing is an integral part of all chemical processing. In spite of this, mixing has proved intractable to a rigid theoretical analysis. Thus in comparison with the more theoretically developed chemical engineering operation, mixing is still regarded as something of an art.

Quillen[1] defines mixing as the "intermingling of two or more dissimilar portions of a material, resulting in the attainment of a desired level of uniformity either physical or chemical, in the final product." Gases, confined in a container, mix rapidly by natural molecular diffusion. In liquids, however, natural diffusion is usually a slow process. To hasten molecular diffusion within liquids, the mechanical energy from a rotating agitator is utilized.

Parker[2] defines agitation as "the creation of a state of activity such as flow or turbulence, apart from any mixing accomplished."

Required mixing time is one of the important parameters in a mixing process. If the time of mixing employed is much longer than the required mixing time, it would waste time and energy. In industry, it means decreasing production capacity and increasing extra expenditure. In many cases excessive agitation can cause segregation of the mixing components. On the contrary, if the time of mixing is insufficient a nonuniform product will be formed.

Many conventional methods can be used to determine the required mixing time [3,4] such as concentration [5,6,7,8], optical [9], dye [10,11] and temperature [12]. Radioactive tracer technique is an interesting technique which has potential in being applied to determine the required mixing time because of its advantages over the conventional techniques. The advantages are the following [7]

1. Measurement of nuclear radiation can be made with extreme sensitivity which means that the amount of tracer required can be kept so small that it will not interfere the process being studied.

2. The measurement is absolutely specific and no substance, unless it is also radioactive can falsely indicate the presence of the tracer or disturb the measurement in qualitative sense.

3. There is a wide choice of isotopes available with a wide range of radiation characteristics and half-life. For every single case a suitable isotope can be chosen to fit the experimental condition.

4. If a γ-emitter isotope is used, measurement of tracer concentrations can be carried out through the pipe or vessel walls, which makes cumbersome sampling unnecessary and also guarantees that the system studied is undisturbed.

5. Radioactive material and radiation detection instrumentation required for industrial tracing are, generally speaking, quite inexpensive.

The purposes of this study were to employ the advantages of radioactive tracer technique in determining the required mixing time and to compare the results obtained to those using conventional technique, the conductivity method.

The mixing system used in this study was a standard configuration flat bottom cylindrical tank. It's diameter was 24 cm and it's height was 30 cm. It was filled with water up to a height of 24 cm. The major interested parameters were

types of impeller	: three types of impeller, 6 bladed open turbine, 6 bladed disc turbine, and 6 bladed 45 degree pitch turbine.
positions of impeller	: at 8 cm and 12 cm above tank's bottom (1/3 and 1/2 tank's diameter respectively)
speeds of impeller	: 200, 300 and 400 rpm
baffles	: with and without baffles installation.

Some experiments were conducted to determine the residence time in steady state continuous flow through two systems. One was continuous stirred mixer. The other was tubular vessel. The varied parameters were :

volumetric flow rate : 5.40, 8.85, 10.70, 11.80, and 14.10 litre/min.

For continuous stirred mixer, the mixer which has the same dimension as mentioned above with baffle installation and impeller located at 1/3 tank's diameter was used by varying the types of impeller. Three types of impeller as mentioned above were used.

For tubular vessel, three sizes of pipe, 3, 4 and 6 in. norminal pipe diameter with volume equal to the volume of water in the tank were used.