

INTRODUCTION :

Flow Injection Analysis (FIA) is an automated method of chemical analysis in which a sample is injected into a flowing carrier solution that mixes with reagents before reaching a detector. Over past 30 years FIA techniques developed into a wide array of applications using absorption spectrophotometric, fluorescence, atomic mass absorption, atomic emission, chemiluminescence, spectrometry, ICP and many other methods of instrumental analysis for detection .

FIA replaces manual methods using lab tubes and beakers. FIA is a simple, automated microchemical technique, capable of a high sampling rate and minimum sample and reagent consumption.

Principles of FIA

In a flow injection system, the reagents, along with a carrier solution, are pumped through tubes in a continuous manner, mixing coils and the flow center in the detector. A small sample of the substance to be tested is injected into the liquid solution where it combines with one or more reagents. The ensuing chemical reaction results in a color change that is measured in the detector. The entire process can be accomplished in approximately one minute with a much smaller sample than required in manual processes.

The reaction time depends on the flow rate and the coil length and diameter, before the sample passes through a detector to waste. A peristaltic pump is the most commonly used pump in FIA instruments.

FIA Instrumentation

The simplest flow injection analyzer consists of a **pump**, which is used to propel the carrier stream through a narrow tube; an **injection port**, through which volume of a sample solution is injected into the carrier stream in a reproducible manner; and a **reaction coil** in which the sample and reagents react .

Ordinarily,

the solution in a flow-injection analysis is moved through the system by a peristaltic pump, a device in which a fluid (liquid or gas) is squeezed through plastic tubing by rollers. The injectors are similar in kind and performance requirements to those used in HPLC.

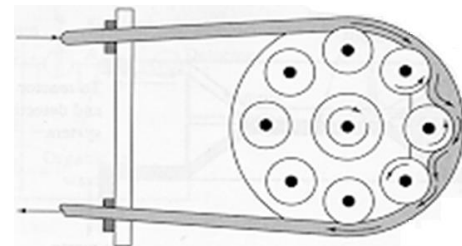
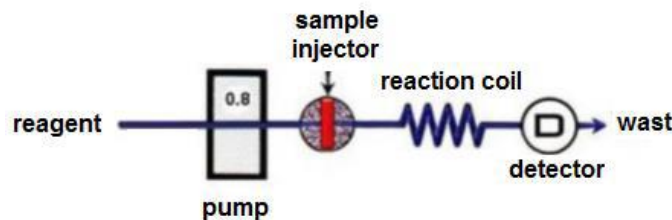
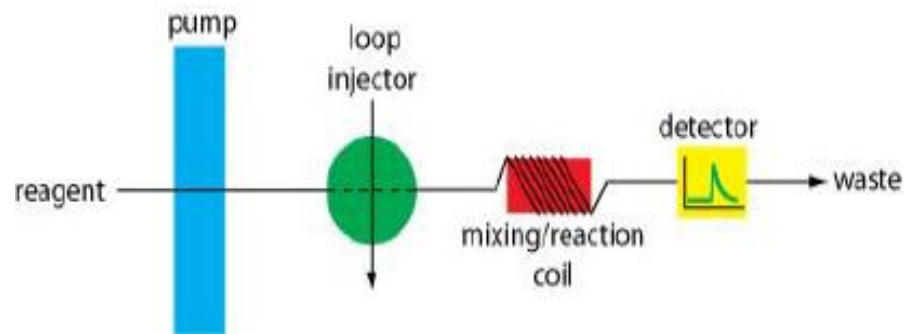


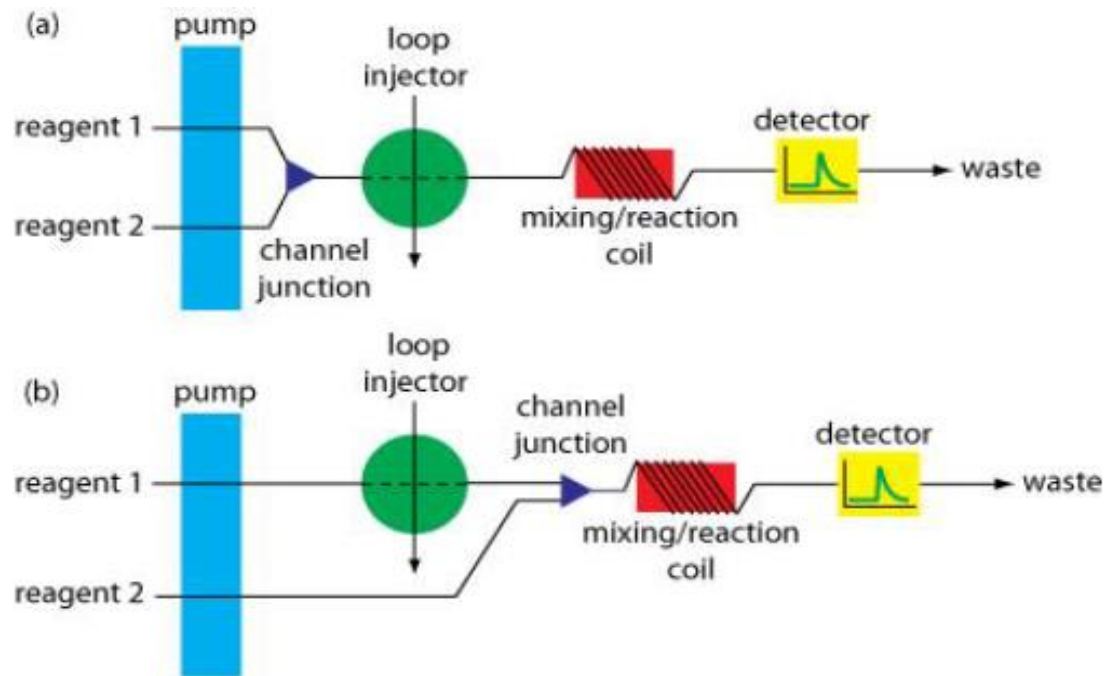
Diagram showing one channel of a peristaltic pump.

As we mentioned before, the detectors used in FIA are mainly spectrometric such as uv/vis spectrometer , fluorimeter , AES , AAS , AFS and chemiluminescence. A typical recorder output has the form of a peak ,the height ,width, or area of which is related to the concentration of the analyte. **The simplest manifold includes only a single channel.** This type of manifold is commonly used for direct analyses that do not require a chemical reaction. In this case the carrier stream serves only as a means for rapidly and reproducibly transporting the sample to the detector.

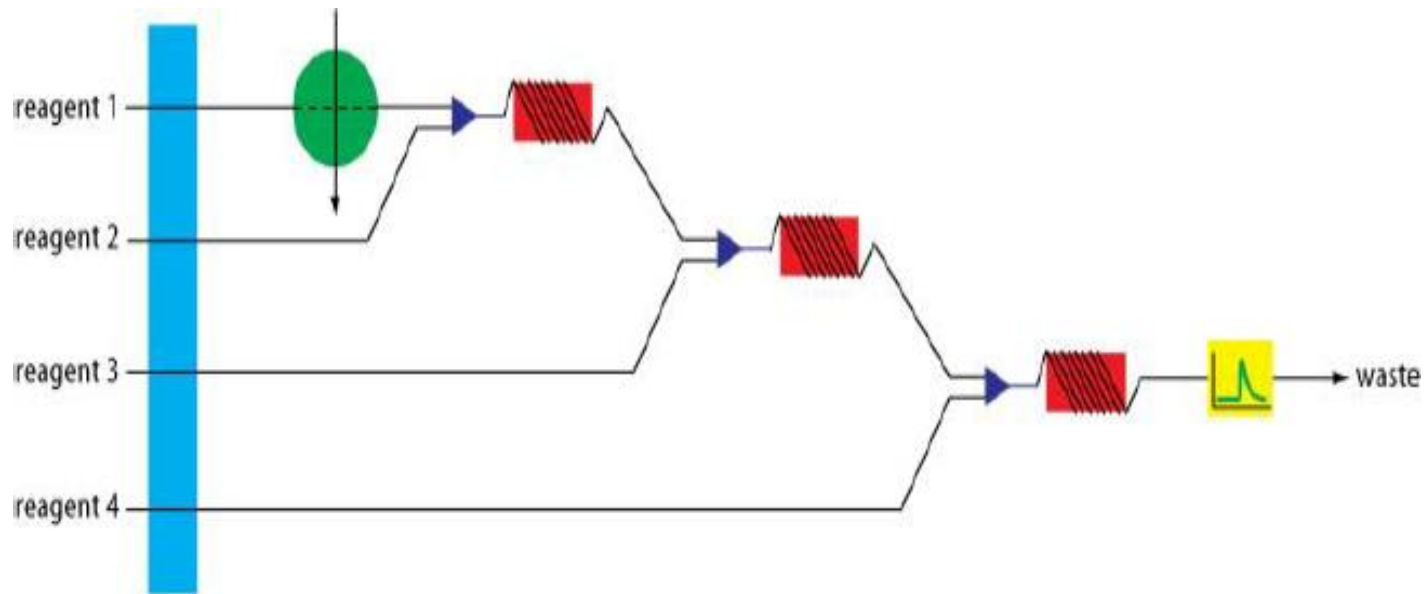
Most flow injection analyses that include a chemical reaction use a manifold with two or more channels .



Two configurations are possible for a dual-channel system are illustrated here: (a) injection of the sample after the mixing of the reagent streams; and (b) injection of the sample into one reagent stream prior to mixing with the second reagent stream. The choice of manifold depends on the chemistry of the reactions between the analyte and the reagents.



More complex manifolds involving three or more channels are common. One example of a four-channel manifold is shown here where sample is injected into reagent 1 then mixed with reagent 2 then reagent 3 then reagent 4 before reaching the detector . **The length of the coils depends on the time of reactions .**



Advantages and Disadvantages of Automatic Analysis

- Automated instruments offer a major economic advantage because of their savings in labor costs.
- Their speed, which is frequently significantly greater than that of manual devices.
- A well-designed analyzer can usually produce more reproducible results over a long period of time than can an operator employing a manual instrument.
- It offers an additional level of protection to technicians when handling or testing toxic substances .
- Separations by liquid/liquid extraction, or ion – exchange ... etc. are readily carried out automatically with flow-injection systems.
- The equipment is computer compatible as well, providing quicker analysis while limiting the data entry errors possible in manual testing .

The main drawback is that it leads to increased unemployment because the number of employees in the laboratory will be reduced because of the lab 's reliance on automatic analysis .

Application

Flow-injection techniques have found considerable application for high-speed feeding of such detector systems as flame atomic absorption and emission as well as inductively coupled plasma and uv/vis molecular absorption and emission .

FIA is employed in monitoring **industrial** processes in the **food** and **pharmaceutical** industries; in **agriculture**; in **environmental** monitoring, such as testing water for contamination; and in life sciences.