



Al-Mustaqbal University  
Department of Medical Instrumentation Techniques Engineering

Class: 2<sup>nd</sup>

Subject: Clinical Chemistry

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## Lect.10-11

# Auto Analysis Instruments

- **Automation** is the performance of operations without human intervention.

تدخل

- Automation may involve **operation** like the preparation of samples, the measurements of responses, and the calculation of results.

- **Automation is used for :** تسهيل الطريقة التحليلية او التقنية
- Facilitating an analytical method or technique
  - Processing of large number samples
  - Determination of several components in the same sample
  - Reduction of human participation
  - To avoid error
  - Process ( industrial or otherwise ) control
  - Lowering consumption of sample and/or reagents  
استهلاك

The Auto Analyzer is an automated analyzer using a flow technique called continuous flow analysis (CFA), or more correctly segmented flow analysis

تقنية الجريان التي تسمى تحليل الجريان المستمر أو تحليل الجريان المتجزأ بشكل صحيح

Continuous flow analysis (CFA) is a general term that encompasses both segmented flow analysis (SFA) and flow injection analysis (FIA). In segmented flow analysis, a continuous stream of material is divided by air bubbles into discrete segments in which chemical reactions occur.

تحليل الجريان المستمر (CFA) هو مصطلح عام يشمل كلاً من تحليل الجريان المتجزأ (SFA) وتحليل الحقن الجرياني (FIA) في تحليل الجريان المتجزأ، يتم تقسيم تيار مستمر من المواد بواسطة فقاعات الهواء إلى أجزاء منفصلة تحدث فيها التفاعلات الكيميائية.

**The continuous stream of liquid samples and reagents are combined and transported in tubing and mixing coils**

التيار المستمر للنماذج السائلة والكواشف تتجمع وتنتقل في الانابيب وملفات الخلط

**The tubing passes the samples from one apparatus to the other with each apparatus performing different functions, such as distillation, dialysis, extraction, ion exchange, heating, incubation, and recording of a signal.**

تقوم الأنابيب بتمرير العينات من جهاز إلى آخر حيث يؤدي كل جهاز وظائف مختلفة، مثل التقطير، وغسيل الكلى، والاستخلاص، والتبادل الأيوني، والتسخين، والحضانة، وتسجيل الإشارة

# Purpose of Autoanalyzers

An autoanalyzer sequentially measures blood chemistry through a series of steps of

- mixing,
- reagent reaction and
- colorimetric measurements.

# A continuous/segmented flow analyzer

- consists of different modules including
  - ▣ a sampler, pump, mixing coils, optional sample treatments dialysis, distillation, heating, etc,
  - ▣ a detector, and data generator.

Most continuous flow analyzers depend on color reactions using a flow through colorimeter



# Principle of operation

- A stream of material is divided by air bubbles into discrete segments in which chemical reactions occur.
  - An essential principle of the system is the introduction of air bubbles.

المبادئ الأساسية لـ SFA هو إدخال فقاعات الهواء. تقوم فقاعات الهواء بتقسيم كل عينة إلى حزم منفصلة وتعمل كحاجز بين الحزم لمنع التلوث المتبادل أثناء انتقالها على طول الأنابيب الزجاجية

- The air bubbles segment each sample into discrete packets and act as a barrier between packets to prevent cross contamination as they travel down the length of the tubing
- The continuous stream of liquid samples and reagents are combined and transported in tubing and mixing coils.
- The tubing passes the samples from one apparatus to the other → each apparatus performs different function, such as distillation, dialysis, extraction, ..., and subsequent recording of a signal.

# Principle of operation

- In Segmented Flow Analyzers (SFA), the sample is mixed with small reproducible volumes of the required reagents  
قابلية للتكرار  
→ air bubbles are introduced into the flow, → creating about 20 - 100 segments of liquid for each sample
- The sample / reagent mixture flows through mixing coils (heated coils) → a color proportional to the amount of analyte in each sample is developed
- The samples with developed color flow through a colorimeter to measure the color



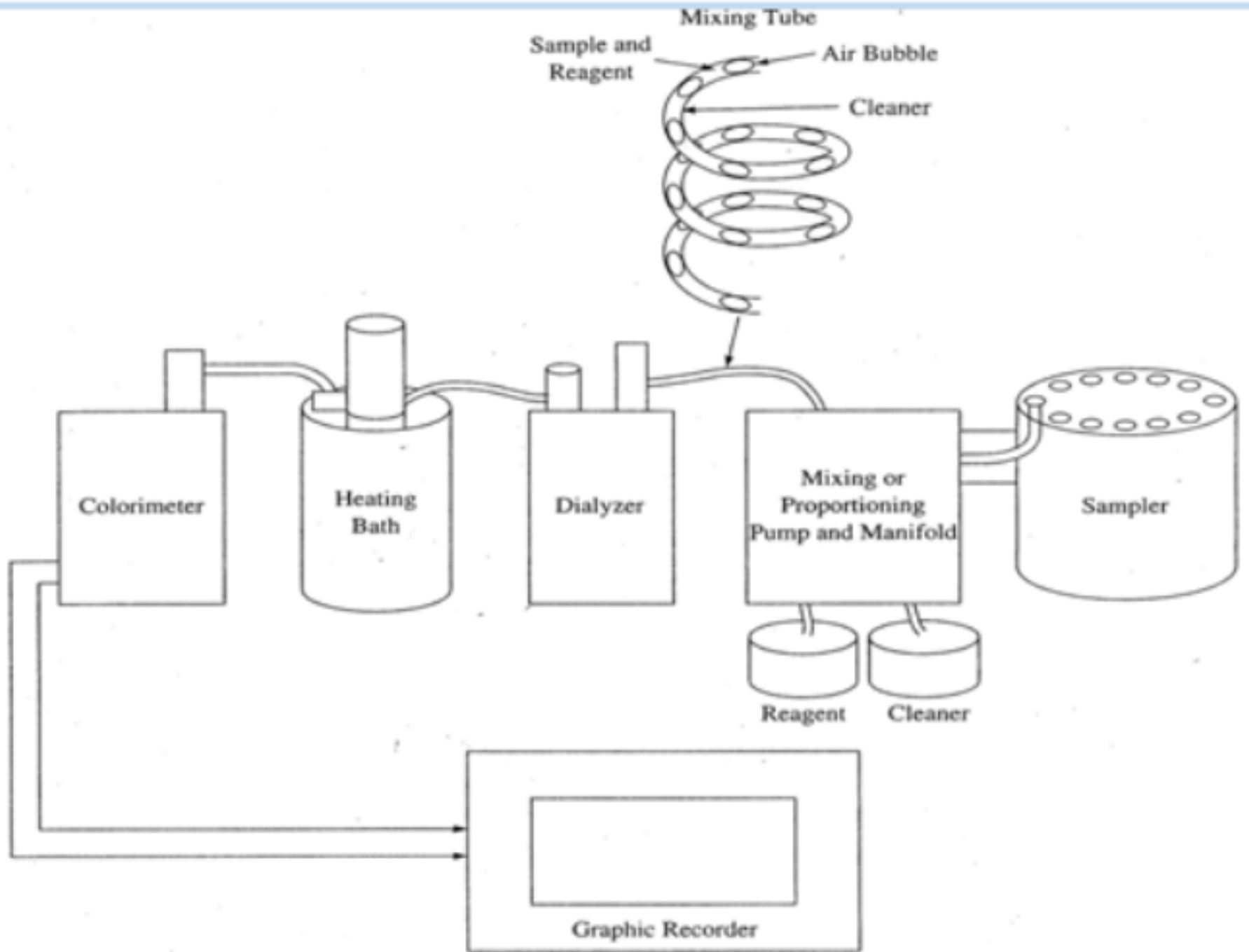
# It consists of

- **Sampler:**
  - ▣ Aspirates samples, standards, wash solutions into the system
- **Proportioning pump:**
  - ▣ Mixes samples with the reagents so that proper chemical color reactions can take place, which are then read by the colorimeter
- **Dialyzer:**
  - ▣ The purpose of a dialyzer is to separate the analyte from interfering substances such as protein, whose large molecules do not go through the dialysis membrane but go to a separate waste stream
  - ▣ The analyte infuses through the diaphragm into a separate flow path going on to further analysis

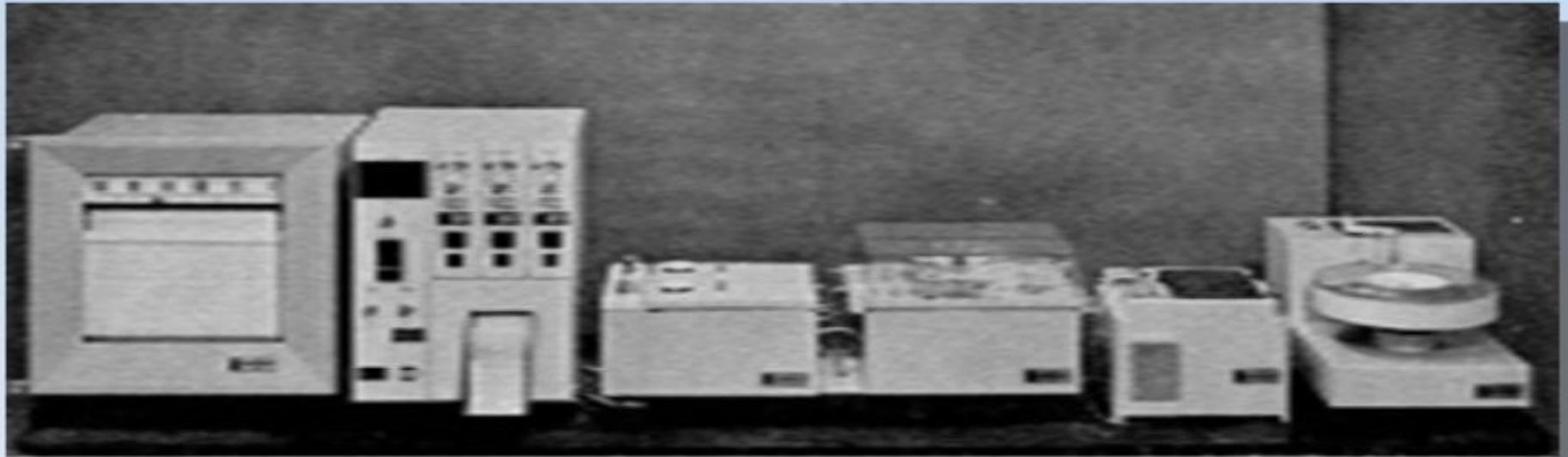
المادة المحللة تنفذ من خلال الحجاب الحاجز إلى مسار جريان منفصل يستمر إلى مزيد من التحليل

# It consists of

- Heating bath:
  - ▣ Controls temperature (typically at  $37^{\circ}\text{C}$ ), as temp is critical in color development
- Colorimeter:
  - ▣ Monitors the changes in optical density of the fluid stream flowing through a tubular flow cell. Color intensities proportional to the substance concentrations are converted to equivalent electrical voltages (Pulses, square wave signal)
- Recorder:
  - ▣ Displays the output information in a graphical form.



# Autoanalyzer



Printer

colorimeter

Proportioning pump

Sampler



# The Auto-Analyzer Consists of:

**1. Sampler:** Aspirates samples, standards, wash solutions into the system

يسحب العينات والمحاليل القياسية و محلول الغسل الى النظام

**2. pump:** Mixes samples with the reagents so that proper chemical color reactions can take place, which is then read by the colorimeter

**3. Dialyzer:** separates interfacing substances from the sample by permitting selective passage of sample components through a semi-permeable membrane

يفصل المواد المتداخلة عن العينة عن طريق السماح بالمرور الانتقائي لمكونات العينة عبر غشاء منفذ

**4. Heating bath:** Controls temperature (typically at 37 °C), as the temp is critical in color development

**5. Colorimeter:** monitors the changes in the optical density of the fluid stream flowing through a tubular flow cell. Color intensities proportional to the substance concentrations are converted to equivalent electrical voltages.

**6. Recorder:** Displays the output information in a graphical form.



# Calibration and adjustment

## Mechanical

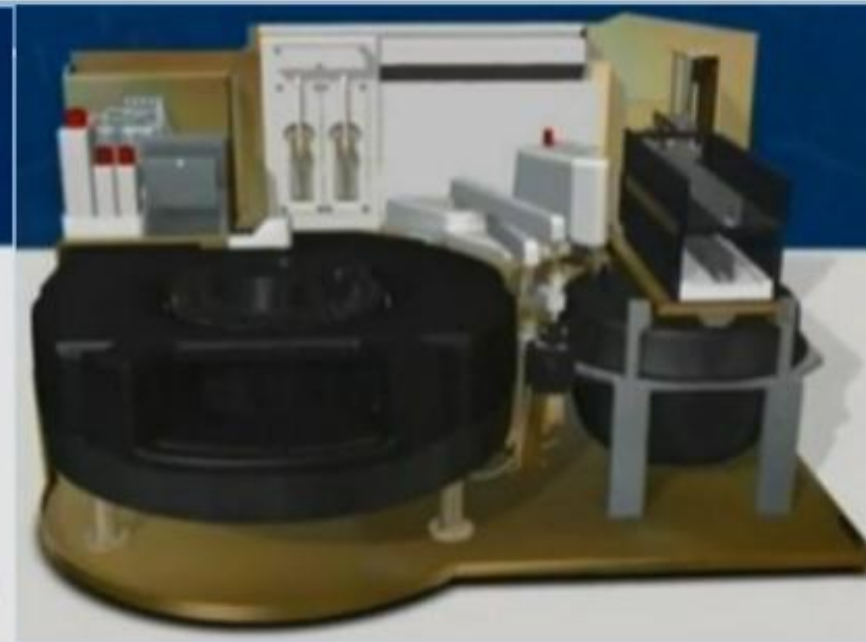
- Tubing
- Moving pump parts

## Electrical

- Switches
- Motors

Electronic failures are rare

# "Another autoanalyzer" "HORIBA



PATIENT			
SERUM	PLASMA	URINE	Whole Blood
ALT AST CHOL HDL Chol CREA CRP GGT GLU TRIG URIC	Na K Cl	$\mu$ ALB	HbA1c