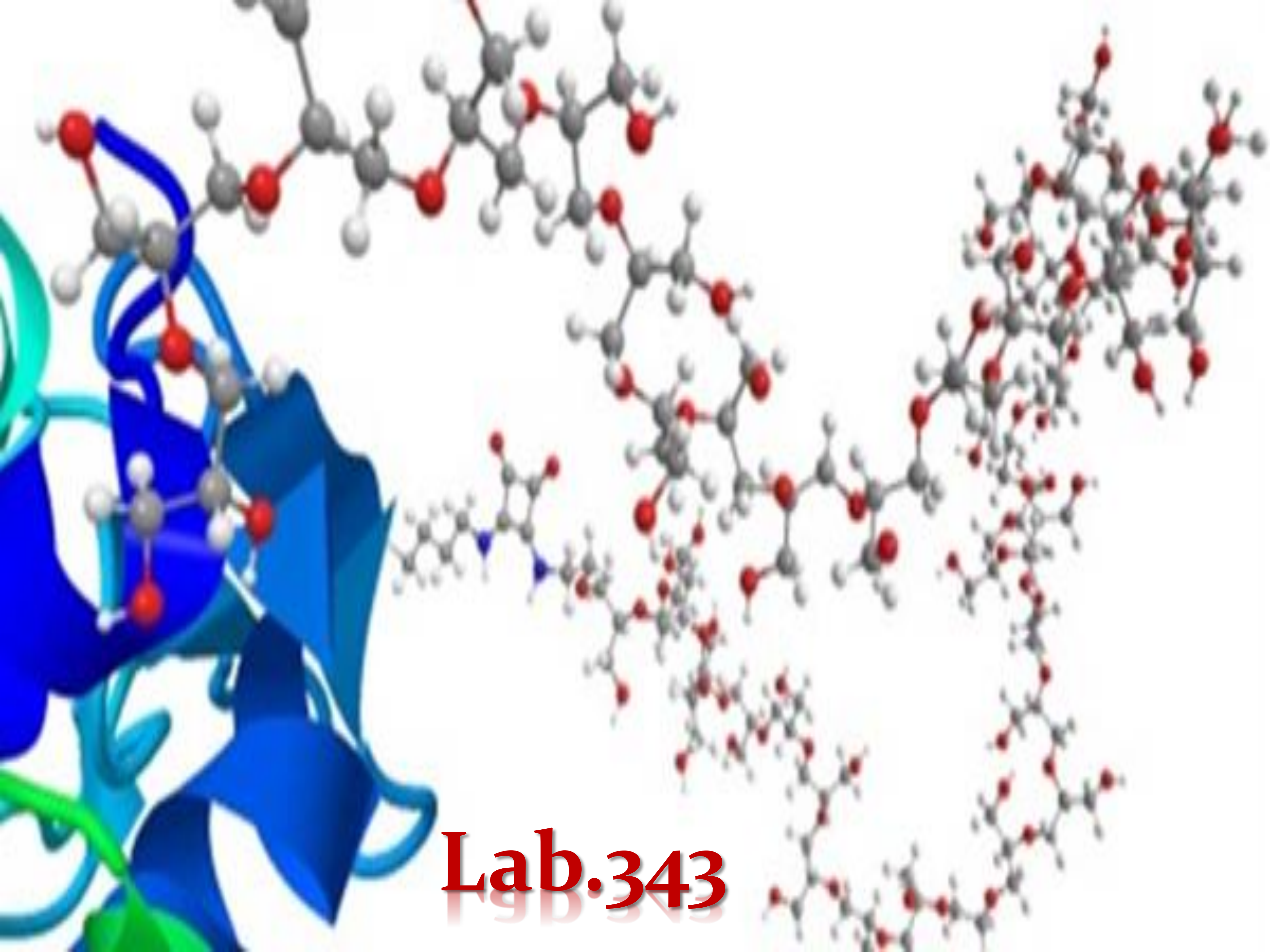


Lab.343

Experiment (9)

Molecular weight of a polymer from viscosity measurements

polymers

are a large class of materials consisting of many small molecules (called *monomers*) that can be linked together to form long chains.

Types of polymers:

1-Natural

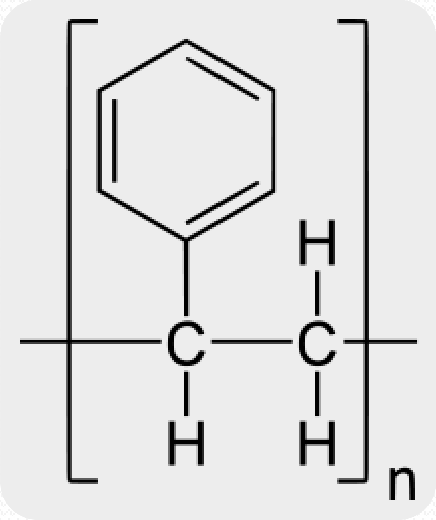
ex. Natural rubber, DNA and proteins

2-Industrial(synthetic)

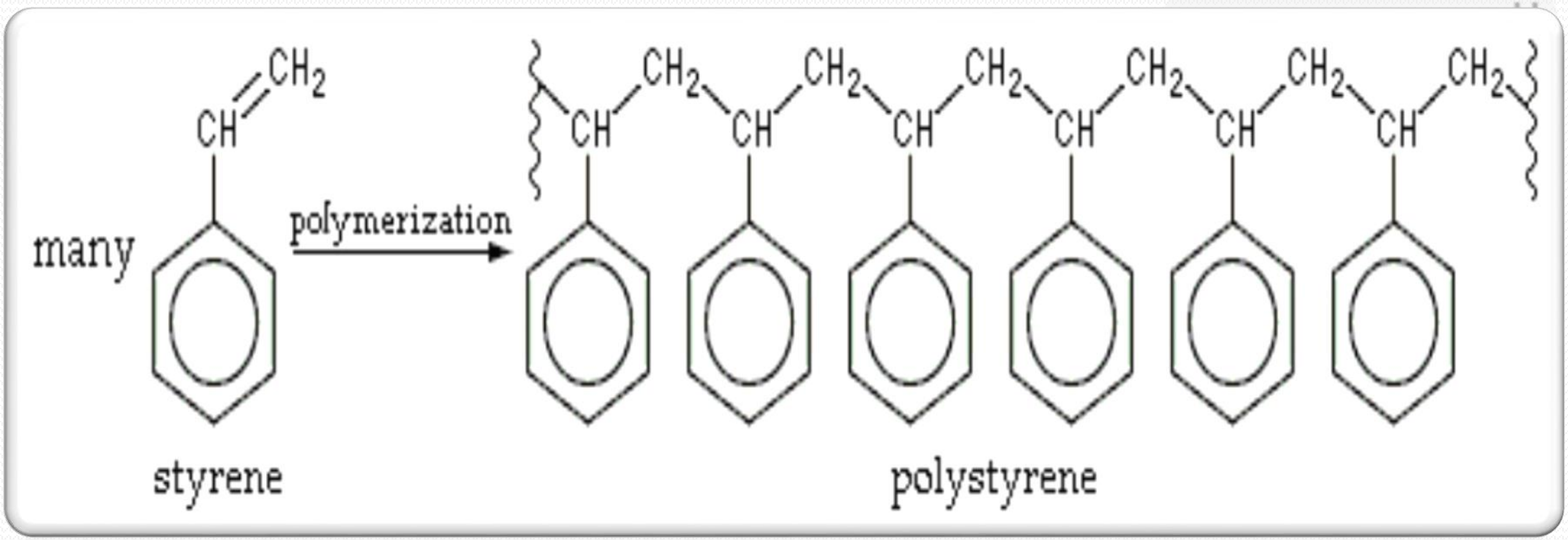
ex. plastics such as polystyrene

Polystyrene

- $(C_8H_8)_n$

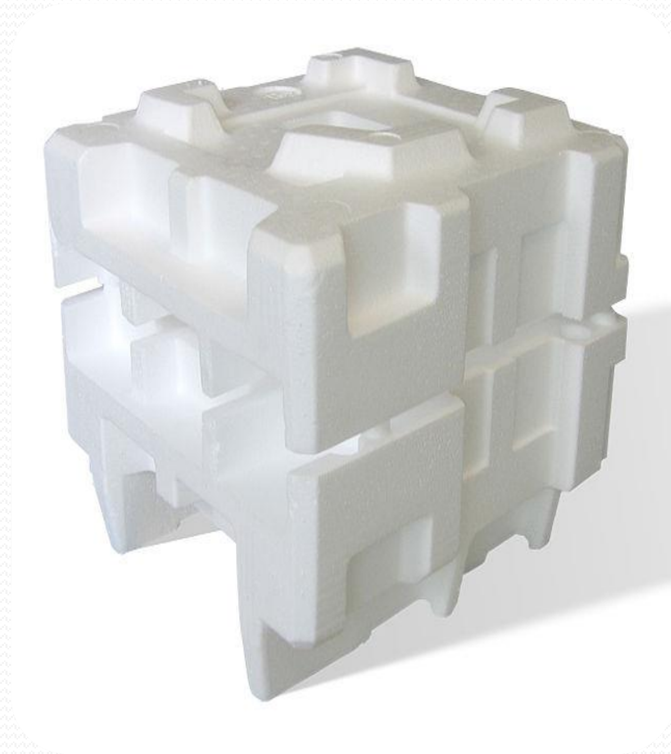


- **Polymerization**









The ratio of the viscosity (η) of a solution polymer molecules to the viscosity ($\eta_\circ$) of the solvent related to the molecular weight M of the polymer

$$\frac{(\eta / \eta_\circ - 1)}{C} = K\,M^{\alpha}$$

K : is a constant for any given type of polymer.
α : is a function of the geometry of the molecule.
C : is the number of grams of polymer in 100 ml of solution.

$(\eta / \eta_{\circ} - 1)$ is known as the specific viscosity

$$\eta_{sp}/C = K\, M^{\alpha}$$

- This equation is only valid for very dilute solution.
- The graph which is drawn of η_{sp}/C vs C.
- Intrinsic viscosity $[\eta]$

$$[\eta] = \lim_{c \rightarrow o} \eta_{sp}/C$$

- Intrinsic viscosity [η]

- Molecular weight

$$[\eta] = K\,M^{\alpha}$$

Procedure:

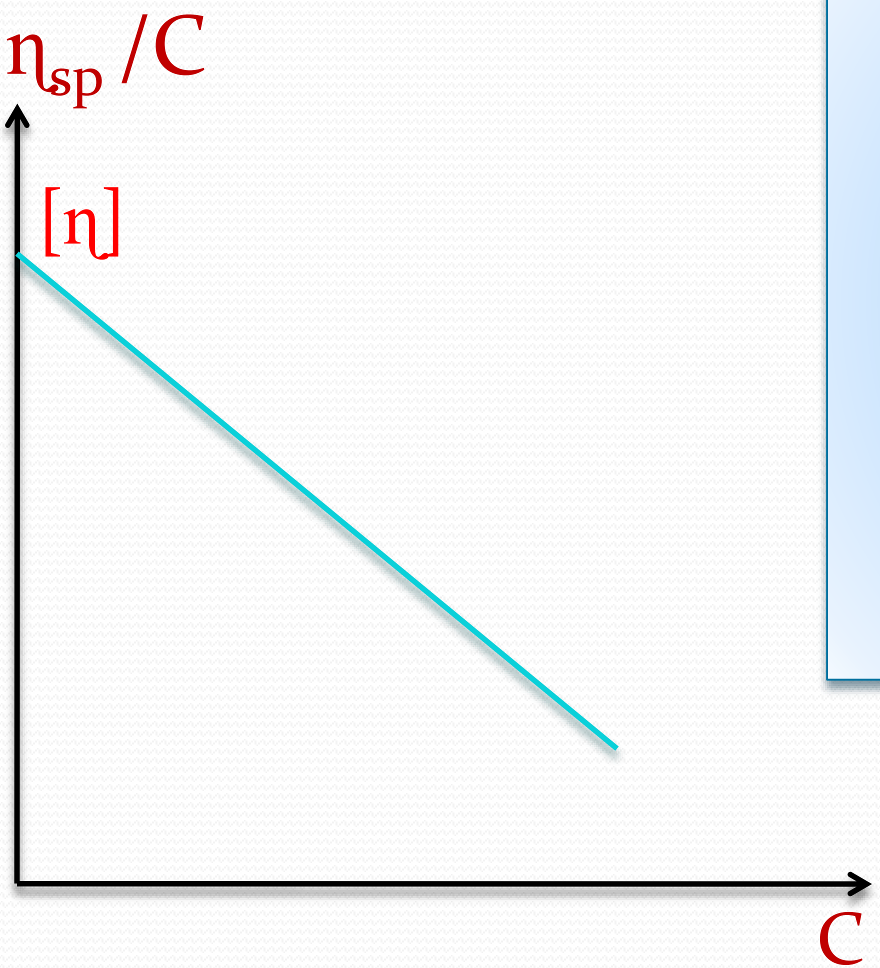
1. Prepare the stock solution of the polystyrene in toluene by weighting 2.5gm of the polystyrene dissolved in 200ml toluene.
2. Make 5 different concentration by diluting the stock solution to 2,4,8 and 16 times.
3. Measure the average time of flow (t) for each of the above 5 concentrations using viscomter at 25°C.
4. Measure the average flow time of toluene ($t_{\circ}$) at 25°C.

Results

C	t= η	t∘ =η∘	η/η∘ = t/t∘	η_{sp} = η/η∘ -1	η_{sp} /C
0.5					
.25					
0125					
.062					
.03125					

$$[\eta] = K M^{\alpha}$$

Polymer-solvent system	K	α
Poly styrene-Toluene	1.05×10^{-4}	0.725



$$[\eta] = K M^{\alpha}$$

$$\ldots\ldots\ldots = K M^{0.725}$$

$$M^{0.725} = \ldots\ldots / K$$

$$0.725 \ln M = \ln(\ldots\ldots / K)$$

$$\ln M = \quad / 0.725$$

$$M = \quad g/mol$$

****Plot { 1/C ln (η / ηo) } vs. C. and compare the results**