6/ The fracture stress of a polymer is related to the ~~number~~ Average number of molecular weight $\overline{M_n}$ by the relationship:- Fracture Stress $= A - \frac{B}{\overline{M_n}}$

(A, B Constants depends on Temp.)

This relation ship holds approximately for brittle strength of several PE Samples, branched PE and brittle polymers.

The yield stresses of different polyethylenes could differ with the degree of branching (which affects the Crystallinity); So the Temp. of brittle-ductile transition would be a Complex function of molecular weight and branch Content.

5. Molecular orientation :- molecular orientation introduces anisotropy of mechanical properties. both the brittle streng th and the yield stress will depend on the direction of the applied stress. The brittle strength is more anisotropic than the yield stress. A uniaxially oriented polymer is more likely to fracture when the

stress is applied perpendicularly to the Symmetry axis than unoriented polymer at the Same Temp. and Strain rate.

Note:- The basis of Commercial processes for manufacturing Synthetic fibers from polymer films is called Fibrillation.

6. Notch Sensitivity:- It is known that the presence of a sharp notch can change the fracture of a metal from ductile to brittle and similar behavior will occur in polymers.

The following classification of brittle-ductile behavior can be ~~applied~~ occured to polymers:-

(1) if $\sigma_B < \sigma_y$ the material is brittle

(2) If $\sigma_y < \sigma_B < 3\sigma_y$, the material is ductile in an unnotched tensile test, but brittle when sharp notch is introduced.

(3) If $\sigma_B > 3\sigma_y$, the material is fully ductile; ductile in all tests including those in notched specimens.

The effect of the notch is to produce a triaxial stress system; the constraints in the contraction of a notched bar produce transverse tensions σ_2 and σ_3 in both the width and thickness directions. There are two types of failure:- triaxial tensile failure which is brittle and shear failure which is tough or ductile.

classification of polymers according to mechanical properties :-

Polymers which are brittle unnotched : PMMA - PS - SAN (Copolymer of styrene and acrilonitrile).

Polymers which are ductile unnotched but brittle notched : (~~Nylon 66~~ Nylon 66, POM (Poly oXymethylene, ~~PC~~ PC, PVC, Polyethylene ~~terephthalate~~ terephthalate Cellulose acetate (CA), PP (Polypropylene).

Polymers which are ductile even when notched :- LDPE, PTFE (Polytetrafluoroethylene), PB Polybutene 1.

The brittle-ductile transition was related to a mechanical relaxation and in particular to the glass transition. This is true for natural rubber, poly iso butylene and ~~polystyrene~~ polystyrene, but is not true for most thermoplastics.