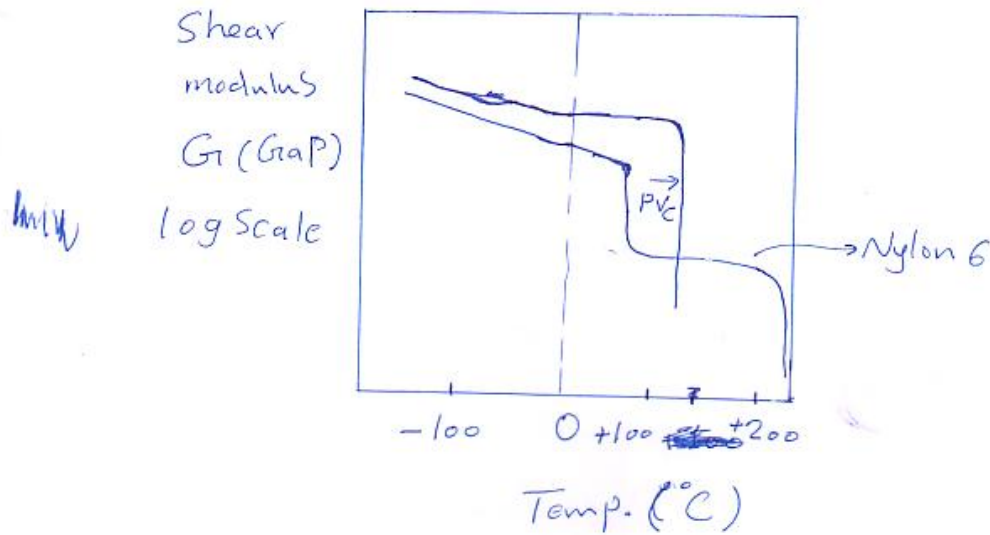


1/ حاضرہ (16) حاضرہ سلوکس میکانیکی / ثالثیہ پولیمر

There are several mechanical relaxations will occur in polymers. They can be presented in the following cases.



In PVC: In the region of -4°C , a small relaxation process (B) causes a dip in G_1 . The major drop in G_1 is at 70°C (the glass-to-rubber relaxation (α)).

In nylon 6 (polyCaprolactam): This polymer has a crystallinity $\approx 50\%$ and shows a series of relaxations as the specimen is heated. The major relaxations are at 50°C (glass to rubber relaxation of the amorphous fraction), and crystal melting point at ~~220~~ 220°C .

Other less intense relaxations of the amorphous fraction occur below 0°C .

~~Among~~ α -relaxation is a major relaxation (glass to rubber relaxation); it represents on the molecular level the backbone snake like motion; ~~this is the~~

β -relaxation is produced from the side group rotation.

In Glassy polymers, there is one relaxation (glass to rubber) and sometimes a smaller secondary relaxation as in (PMMA, PVC, and PC). Crystalline polymers usually have several relaxations.

The working temp. range for PVC is $(-30 \text{ to } +50)^{\circ}\text{C}$.

= = = = = nylon 6 is $(-30 \text{ to } +150)^{\circ}\text{C}$.

The upper use Temp. is determined by the onset of the glass to rubber relaxation (α).

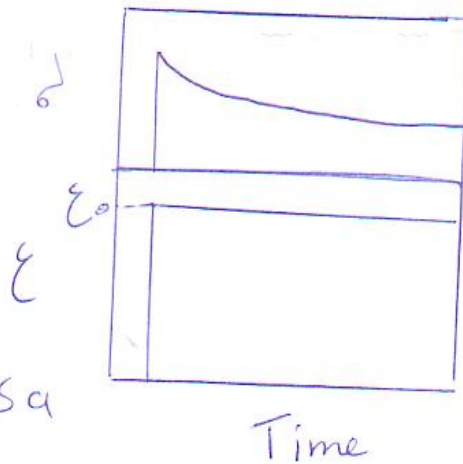
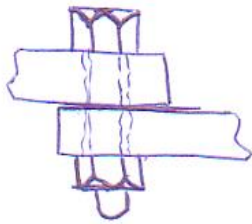
For PVC (below -40°C); β -relaxation transforms the polymer from a brittle to a reasonably ductile glass.

Note: The upper use Temp. can be extended by reinforcement with glass or Carbon fiber ~~to produce~~ or with mineral particles. This is true for all thermoplastics particularly the Crystalline thermoplastics.

Case studies

In design, the constraint is sometimes a constant strain, the stress being the dependent variable. Consider a nylon bolt used to join two rigid plates. When the bolt is tightened suddenly it is stretched, the tensile strain in the bolt increasing to a value ϵ_0 and then remaining constant.

If the bolt were elastic, the resulting tensile stress will be increased and remained constant. In practice, because it is v. E., nylon exhibits stress relaxation. The stress relaxation of polymer gaskets and washers is also of considerable importance.



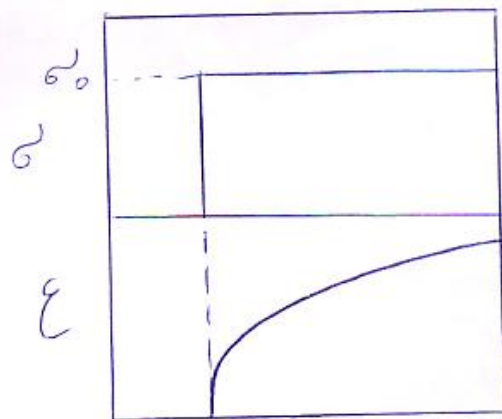
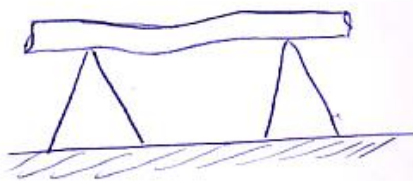
Stress decay in a bolt as a function of time after tightening

The strain is constant

Case Study - 6

For Creep:- in design, the stress is held constant. For example, Consider a high density poly ethylene pipeline supported above ground on brackets at regular intervals along its length. At the moment during construction when the pipe is raised on to its supports, any element of the pipe is suddenly subjected to a bending stress (σ_0) due to the self weight of the pipe, which remains const.

The resulting strains in the pipe cause it to sag between supports. These strains, and the deflection, would be constant for an elastic pipe, but since PE is V.E. the strains increase with time, causing the pipe gradually to sag. The designer of the pipeline would need to allow for creep of the pipe when deciding the distance between support brackets.



The increasing sag of the V.E. pipe. Constant stress due to weight of the pipe leads to a Time dependent strain