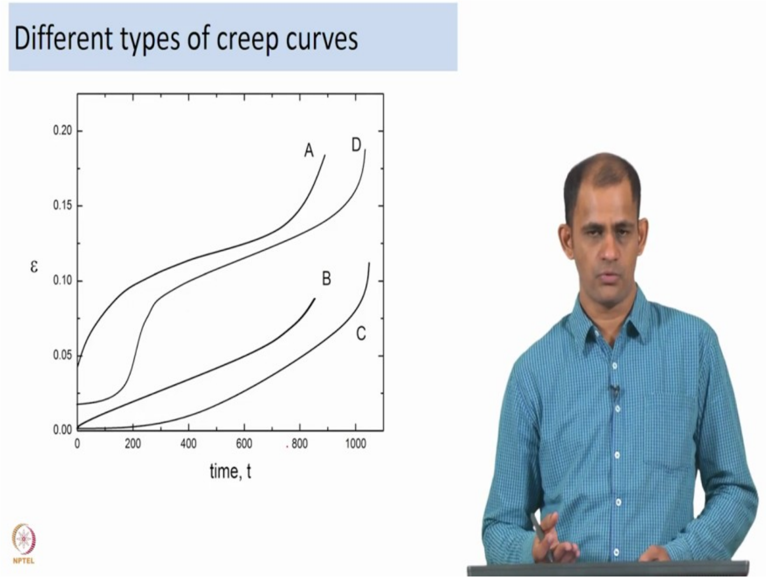
Creep Deformation of Materials
Dr. Srikant Gollapudi
Department of Mathematics
Indian Institute of Technology, Bhubaneswar
Part 5
Creep and different Factors That Influence Creep Deformation-Part 5.

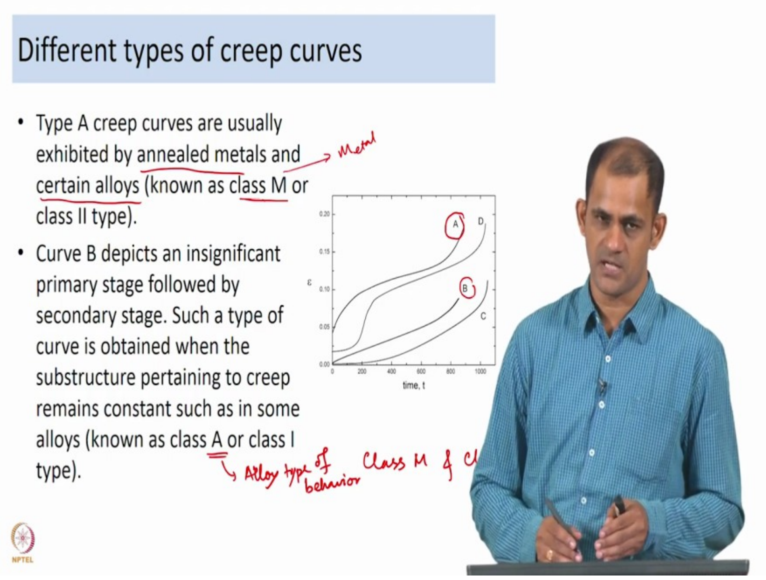
(Refer Slide Time: 0:15)



So here, so far we have been talking about creep, how the creep curve looks like, we talked about the different types of curves, the creep equation and the genesis of the creep equation. We also talked about the strain rate of deformation and how strain rate of deformation depends on the applied stress. We determined the strain rate of deformation is a function of these different factors. And what we found out is the creep could happen by different mechanisms depending on these factors and these mechanisms are described or defined by the values of p and Q and also that constant A.

Now one of the things that I mentioned in the beginning of the lectures on creep, that the shape of the creep curve is also dependent on the type of mechanism. Since we are talking about mechanisms, I would also want to point out that the shape of the creep curve depends on the type of mechanism that is in operation. So you could have different types of creep curves and, so in this particular slide I am showing you 4 types of creep curves A, B, C and D, all of them are very different from each other.

(Refer Slide Time: 1:40)



And this is a representative of the different type of creep curve that you could see and depending on how the plastic deformation is happening, you could have A or you could have B, C or D. So, for example, type A curves, this how a regular creep curve looks like, are usually exhibited by annealed metals and certain alloys known as class M or class II types of alloys. So these are, this is a typical creep curve where you have an instantaneous strain and then you have a primary creep and then you have a steady-state creep rate followed by tertiary creep at failure.

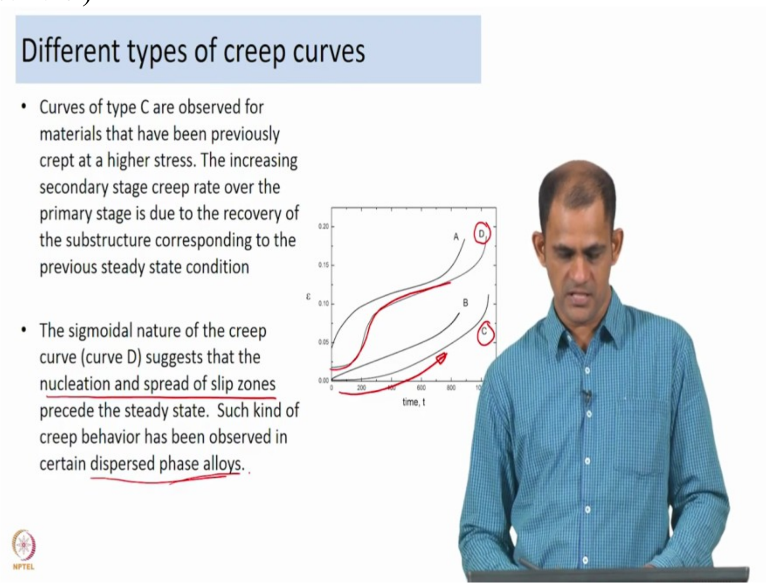
So this type of a creep curve is generally exhibited by annealed metals and certain type of alloys, known as a class M alloys, class M means metal type of alloys. So, we are going to talk about this in the coming portions. Now let us look at curve B, so if you see curve B depicts an insignificant primary stage. So here the primary state is very small, so we see a secondary stage, the primary stage is followed by a secondary stage.

So the primary state is small and such type of creep curve is obtained when the structure pertaining to creep remains constant, such as in some alloys known as class A or class I type. So we are introducing 2 types here, class M and class A type of materials of alloys are materials. Class M corresponds to metal type of behaviour, class A corresponds to alloy type of behaviour. So, B, the curve, the creep curve B is generally seen in alloy type of material and the alloy is known as class A type of alloys.

And the thing to note here is the curve, this type of recovery is obtained when the substructure pertaining to creep remains constant. Now in the beginning of the creep lectures we were talking about how during creep deformation the substructure is evolving, especially in the primary creep stage. And the primary stage, it evolves and finally stabilises and when it stabilises, that is where you start seeing the secondary can keep stage.

So during primary creep stage, you have a substructure that is evolving but if the substructure does not evolve but if it stays constant, then your primary creep is stabilised very quickly, then your primary creep stage is also going to be small. And that is what is happening in type B where the substructure is constant more or less right for the beginning. And that is why you primary creep stage is small.

(Refer Slide Time: 4:19)



Type C, curves of type C are observed for materials that have been previously crept at higher stresses. Increasing secondary stage creep rate compared to the primary stage is due to the recovery of the substructure corresponding to the previous steady-state condition. In this case the deformation history corresponds to creep at higher stresses and then the same sample is now crept at a lower stage lower stress then type C type of curves will be observed. So here if you see whatever substructure that was created at a higher stresses is going to be recovered when you carry out the same test at a lower stress.

And because recovery happens faster, when compared to strain hardening we know that the rate of creep is going to be higher. So that is why if you see the creep rate is increasing because this is recovery dominated creep behaviour. And finally curve D, so the Sigmoidal nature of the creep curve, so it is a sigmoidal type of creep curve. So the sigmoidal nature of the creep curves, this type of the creep curve is observed by the deformation involving nucleation and spread of slip zones preceding the steady-state.

So here there are certain slip zones that are nucleated and these slip zones spread out and when that happens that precedes the steady-state, the D type of creep curve is seen. And the alloys which demonstrate this kind of creep curve are certain types of dispersed phase alloys. So if you have a dispersion of a phrase in certain material, then you might come across such type of creep curves. So these are broadly the different types of creep curves that one may encounter and what I have outlined or inform you is what could be the possible reasons behind the observation of these types of creep curves.