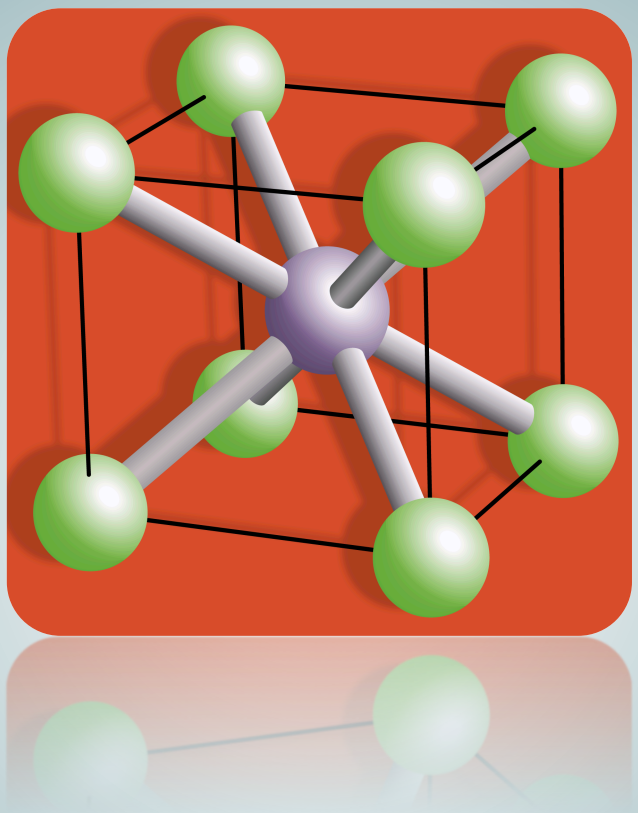
Materials

Exercises Topic 6. Fracture



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FRACTURE

1. A thick plate of large dimensions is examined by X-rays techniques, and any crack wasn't detected. The tool employed can detect edge cracks from a=1mm deep. The steel of the plate has a fracture toughness of K_{IC} = 53 MN.m$^{-3/2}$ and its yield stress is σ_Y = 950 MN·m^{-2}. Supposing that the plate has cracks of a value around the detection limit, determine if the plate will suffer general yielding or if it will fail by a brittle fracture prior to this. Calculate the stress for which brittle fracture will occur.

Data: $K_I = Y\sigma\sqrt{\pi \cdot a}$ (infinite plate with edge crack Y=1).

2. Next data were obtained from a set of Charpy impact tests using standard specimens of 10x10x55mm with a centered V-notch of 2mm (8x10mm of net section). The materials tested were carbon steels with a variable Mn content.

Temperature (°C)	*Impact Energy (J)*			
	0% Mn	*0.5% Mn*	*1% Mn*	*2% Mn*
-50	*10*	*10*	*10*	*10*
-25	*15*	*15*	*20*	*290*
0	*18*	*20*	*40*	*290*
25	*20*	*35*	*100-275*	*290*
50	*25*	*60*	*275*	*290*
75	*30*	*230*	*275*	*290*
100	*45*	*230*	*275*	*290*
125	*180*	*230*	*275*	*290*

a) Represent the graphs "Impact Energy by area unit" vs "temperature" E(J)-T(ºC).
b) On the graphs, stablish the areas where ductile and brittle behavior is expected.
c) Estimate 50% ductile – 50% brittle transition temperatures in each case, and stablish the influence of the Mn content in this variable.
d) Select the most convenient steels for a facility in an area with temperatures under -20ºC.