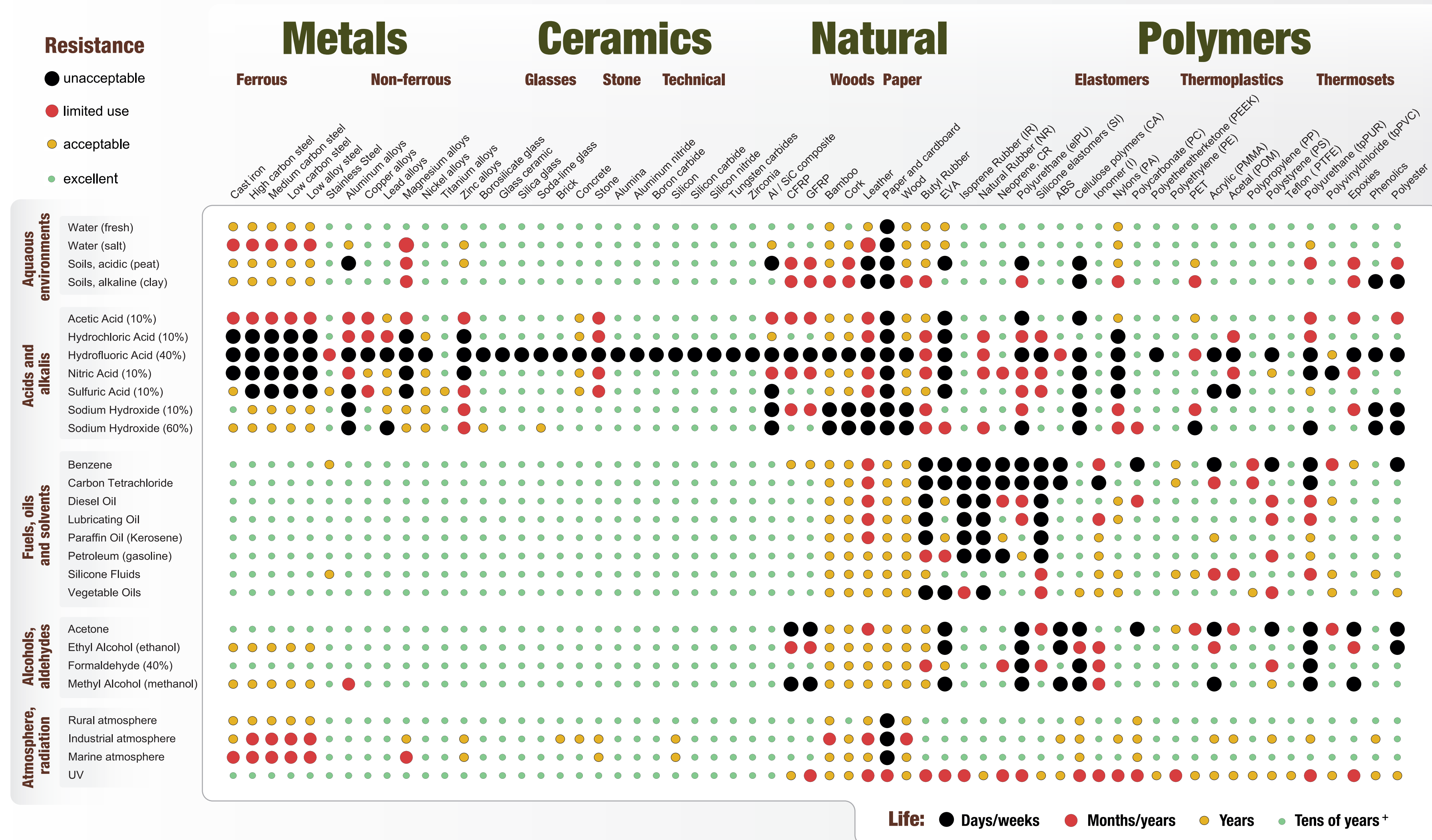


Durability of materials



Standard reduction potentials

Noble metals		
$\text{Au} \rightarrow \text{Au}^{+} + \text{e}^{-}$	+1.5	 <i>Wet corrosion not possible</i> 
$\text{Pt} \rightarrow \text{Pt}^{++} + 2\text{e}^{-}$	+1.2	
$\text{Hg} \rightarrow \text{Hg}^{+} + 2\text{e}^{-}$	+0.95	
$\text{Ag} \rightarrow \text{Ag}^{+} + \text{e}^{-}$	+0.8	
$\text{H}_2\text{O} + \frac{1}{2}\text{O}_2 + 2\text{e}^{-} \rightarrow 2\text{OH}^{-}$	+0.4	
$\text{Cu} \rightarrow \text{Cu}^{++} + 2\text{e}^{-}$	+0.34	 <i>Wet corrosion usual</i> 
$\text{H}_2 \rightarrow 2\text{H}^{+} + 2\text{e}^{-}$	0.0	
$\text{Pb} \rightarrow \text{Pb}^{++} + 2\text{e}^{-}$	-0.13	
$\text{Sn} \rightarrow \text{Sn}^{++} + 2\text{e}^{-}$	-0.14	
$\text{Ni} \rightarrow \text{Ni}^{++} + 2\text{e}^{-}$	-0.25	
$\text{Fe} \rightarrow \text{Fe}^{++} + 2\text{e}^{-}$	-0.44	
$\text{Cr} \rightarrow \text{Cr}^{+++} + 3\text{e}^{-}$	-0.74	
$\text{Zn} \rightarrow \text{Zn}^{++} + 2\text{e}^{-}$	-0.76	
$\text{Mn} \rightarrow \text{Mn}^{++} + 2\text{e}^{-}$	-1.63	
$\text{Al} \rightarrow \text{Al}^{+++} + 3\text{e}^{-}$	-1.63	
$\text{Mg} \rightarrow \text{Mg}^{++} + 2\text{e}^{-}$	-1.66	
$\text{Na} \rightarrow \text{Na}^{+} + \text{e}^{-}$	-2.37	
$\text{Li} \rightarrow \text{Li}^{+} + \text{e}^{-}$	-3.05	
Reactive metals		

Durability

Durability in liquids and industrial atmospheres is central to the safety and life of products. It is hard to deal with for the following reasons:

- It is a function of both the material and the environment in which it operates
- There are many mechanisms, some general, some peculiar to particular materials and environments
- Material combinations (as in galvanic corrosion) and configuration (as in crevice corrosion) play a role

The **Matrix** on the far left shows the resistance of 61 engineering materials to degradation in 27 common environments.

The diagram next to it ranks metals by their **Standard Reduction Potential** relative to a hydrogen electrode. When two metals are joined in a conducting solution the difference between the reduction potential drives corrosion.

Material selection

The CES EduPack software contains the Matrix data. This allows its selection methods to select a material for a component, with additional constraints on the environment in which it must function. This is the procedure:

- Open CES EduPack Level 2. Select the subset "Edu Level 2 with durability properties"
- Open a LIMIT stage. Open the relevant "Durability" folder. Find the environment and choose "Excellent", or, if the design life is short, both "Excellent" and "Acceptable" (click on both)
- Proceed as usual to apply Graph, Limit or Tree stages

The three **charts** opposite show strength-density charts. The first has no durability constraint. The second is limited to materials that have excellent durability in NaOH solution. The third is limited to materials excellent in diesel oil and gasoline. The guide-lines allow selection for strength at minimum weight with the durability constraint applied. The same constraint can be applied to any other selection.

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