Copper, Lead, and Arsenic Inter- element XRF Monkey Business

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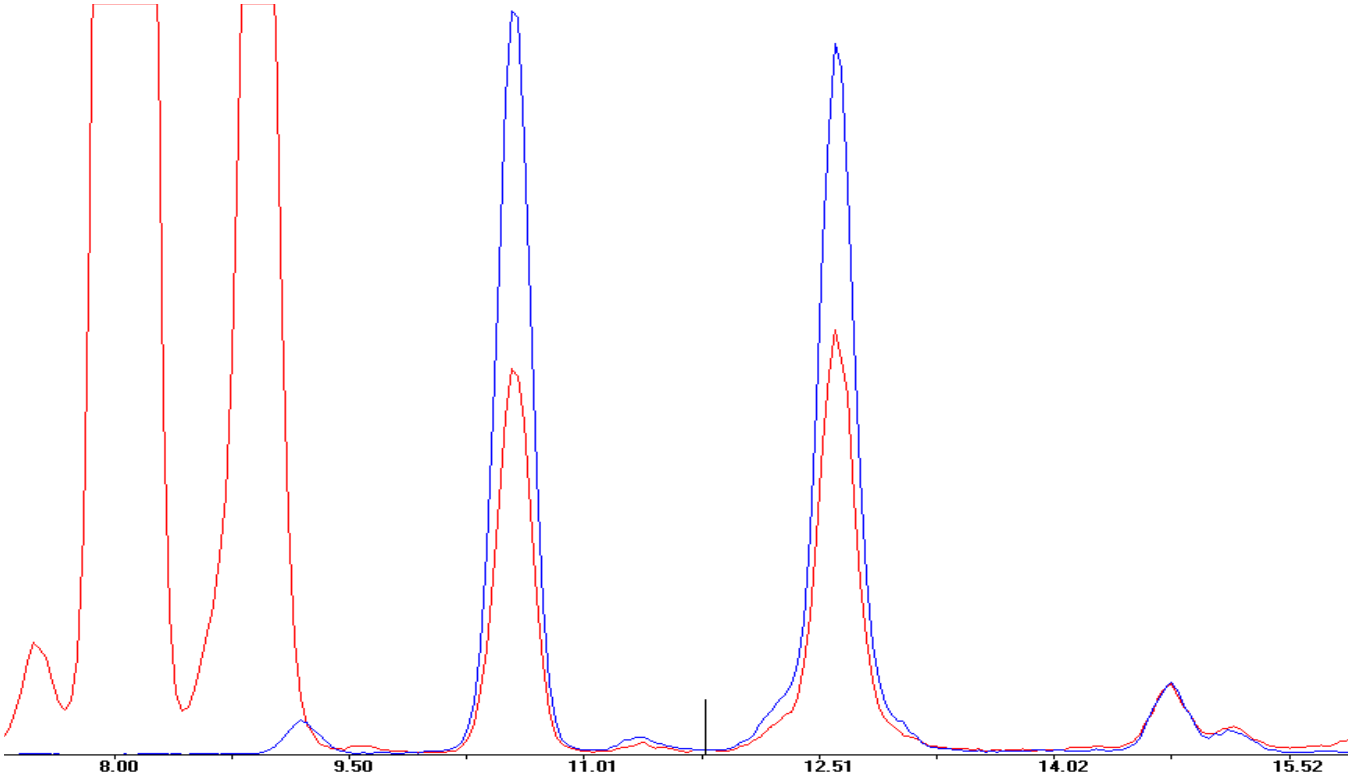
The physics of copper, lead, arsenic and x-ray fluorescence is very complex. To begin with they strongly interact with each other! Copper's absorption edge is at 9keV. Lead has major L lines at 10.6, 12.6 and 14.8 keV . In just that short range the mass attenuation coefficient of copper goes form 278 gm/cc to 74 gm/cc. So while we are effectively creating lead x-rays the copper is absorbing them almost as quickly. And it absorbs the 10.6 a factor of 2 better than the 14.68keV ones. So, when you have pure Lead spectrum (**BLUE**) the peak ratios are very different than when you have a copper alloy with lead in it, as you can see in the **PINK** UPB 82 copper alloy spectrum below.



So in the case when just lead and copper are present you can use this information to determine whether the lead is on the surface, in which case the spectrum should look more like the blue spectrum above. This might indicate that the copper has corroded away leaving lead on the surface.
Or if the 3 lead peak ratios look more those in the pink spectra above you can assume that the lead is dispersed in the copper. Note that the 10. 6 keV peak is more effected than the 12.6 keV peak. These spectra were normalized to the 14.68 peak.

So, when you have pure Lead spectrum (BLUE) the peak ratios are very different than when you have a copper alloy with lead and arsenic in it, as you can see in the **PINK** 7134 copper alloy spectrum below. Note however that the 10.6 keV line is now above the 12.6 keV line in the pink spectra, almost matching the pure lead ratio of these 2 peaks. This is caused by the presence of a small amount of arsenic which has a K alpha line at 10.7 keV. You can see the very small K beta of arsenic at 11.7keV. So you can still see the copper effect of both lines relative to the 14.7 keV lead line but the ratio of the 2 lower energy lines is not the same as when there is no arsenic. These spectra were normalized to the 14.7 keV.