Copper slag using as abrasive blasting and heavy metal contamination, case study Van Phong bay, Vietnam

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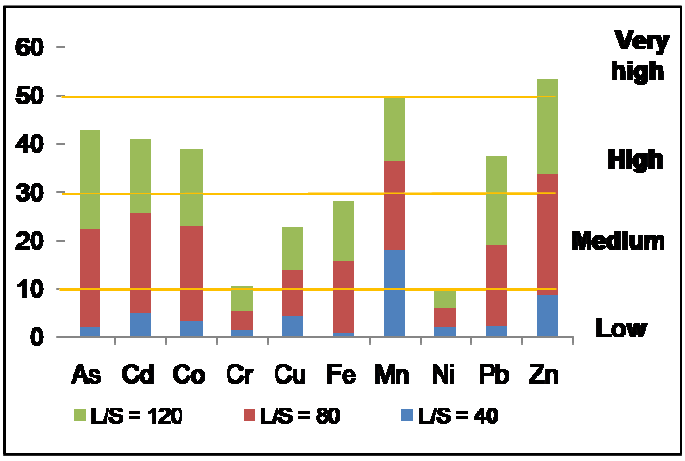
In recent years, shipping industrial activities developed in Van Phong bay (South-Central Vietnam) have raised an urgent environmental concern related to the use of copper slag as abrasive material for removing rust and marine deposits from ships (Le 2003). This study was conducted to investigate the heavy metal contamination in sediments collected nearby the area of the shipping company in Van Phong bay using sediment quality indices. Furthermore, some single extractions were performed to examine the actual and potential mobility of heavy metals from the spent copper slag and sediment (Quevauviller 1998). The obtained results indicated that sediments at Van Phong bay were characterized by a low clay mineral and organic matter content and a low cation exchange capacity. The carbonate component (inferred from Ca content) was dominant in all sediments (25 weight %). A combined approach using sediment quality guidelines (SQGs) and different quantitative indices (Geo-accumulation Index- I_{geo}, Enrichment Factor- EF, Pollution Load Index – PLI and Risk assessment Code – RAC) was used to investigate the pollution status for each heavy metal in the area (Perin et al. 1985, Loska et al. 1997, CCME 1999, Passos et al., 2011). Arsenic shows the greatest concern because of its high EF and I_{geo}. Zinc, Cu, Pb and As possess a “high risk” in the sediment and spent copper slag to environment due to the high RAC. The following figure (Figure 1.1) shows the level of risk from the examined sediments.



. **Figure 1.1.** Level of risk in sediment

Some marine sediment samples adjacent to the abrasive blasting working area can be considered as hot spots of pollution because of the high value of all quantitative indices, classified in SQGs in the highest class: “causing adverse biological effects”. Results from the single extractions suggest that heavy metals in both sediments and spent copper slag show a low actual mobility (according to $CaCl_2$ extraction) and were not easily mobilized by sea water (extractability < 1% of total concentration by NaCl extraction) and organic complexion (extractability < 10% of total concentration by EDTA extraction). Extraction with CH_3COOH was used to assess the acidification on heavy metal release. The ratios of extractabilities using EDTA (to assess the effect of complexation on heavy metal release) and CH_3COOH (to assess the effect of acidification on heavy metal release) were calculated to find out whether heavy metal release was most affected by acidification or complexation reactions. These ratios suggest that acidification has a more pronounced effect on heavy metal release both in sediments and spent copper slag (except for Cd and Pb having a ratio higher than one in sediments). The following figure shows (Figure 1.2) the extractability of As and pH variations in sediments during CH_3COOH extraction at three consecutive extraction steps.

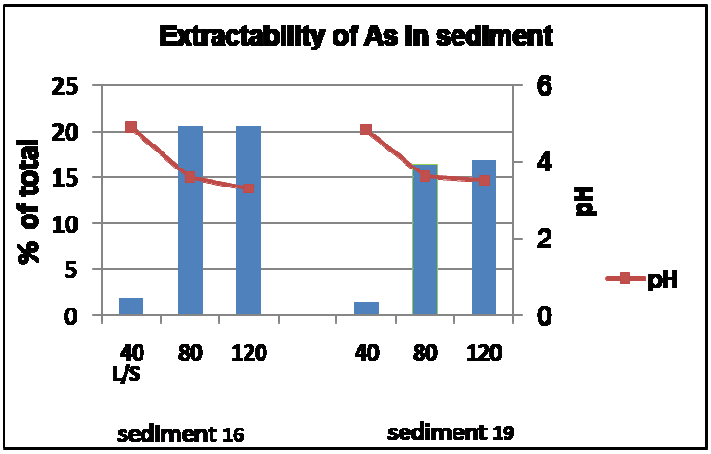


Figure 1.2. Extractability of As in sediment during CH_3COOH extraction

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