Ms. Sabiha Javied

DCHE

Abstract

Modern agricultural practices are depleting natural mineral content of soil required for efficient growth of plants. In order to overcome the reduction of minerals in soil, different approaches are used; e.g. use of manure, organic and inorganic fertilizers etc. Application of phosphate fertilizers is one of the options. Unfortunately addition of desired minerals through fertilizers also accompanies the undesired heavy metal content (stable and/or radioactive). Continuous application of fertilizers may result in buildup of heavy metals, thus, posing a threat to the environment and plants, and consequently to human life. The present study was conducted to investigate the extent of the threat caused not only by phosphate fertilizers (PFs) but also by phosphate rock (PR) and precipitated calcium carbonate (PCC). Representative samples of PR from Hazara deposits, Pakistan, various types of PF used in Pakistan and the fertilizer waste, PCC, from a local fertilizer industry, were taken and analyzed for their radioactive and heavy metal content. Radioactivity was measured by gamma spectrometry using high purity germanium (HPGe) detector while heavy metals were determined by instrumental neutron activation analysis (INAA) technique. Some of the elements were also determined by atomic absorption spectrometry (AAS). Major chemical composition for rock samples was quantified by X-ray fluorescence (XRF) spectrometry technique. Variable amounts of elements like Ba, Sn, Th and V and rare earth elements (REEs) were present in all the studied sites of phosphate rocks. The elements Al, Cr, Cs, Fe, Sb and Zn were present in relatively higher amounts in Kakul phosphate rock crushing plant (KPRCP). Analysis of toxic elements depicts that Pb is present at relatively higher level in local phosphate rock samples while Cd and Zn are present in comparable amount. Assessment of hazards posed by heavy metals in PR showed that consumers are exposed to heavy metals from various pathways. The results indicated that Pakistani PR is agronomically effective. However, it contains higher values for toxic element like

Ni, Pb and Cu that may be transferred to fertilizers and then to soil and plants grown on them thus threatening human life. The specific activity analysis showed that outdoor and indoor external dose from PR is higher than the maximum value of world's soil background level. It was noted that all of the studied phosphate fertilizers are rich in their mineralogical (Fe, K, Mn and Na) content while NPK fertilizers contain relatively higher amount of K. The activity concentrations of ^{40}K and ^{232}Th in the single superphosphate (SSP) fertilizer are lower than that of phosphorite of Pakistan. Monitoring of radon indicated greater risk for miners than the personnel working in fertilizer warehouses. Variations in heavy metal content for PCC may be due to the fact that the collected waste samples were produced from vartious batches of fertilizer production. The average value for outdoor and indoor external dose from PCC waste is about three times and twice the background median value of absorbed dose of gamma rays from worldwide soil respectively. This indicates the level of radiological hazard from PCC waste to surrounding environment. Corresponding effective dose was 1.2 ± 0.1 mSv y^{-1}, which is higher than the annual limit of 1 mSv recommended by ICRP. The analysis of soil and crop samples (edible parts of rice, wheat and mungbean) was also performed and transfer factor (TF) from soil to crop was calculated. Greater TFs for Al, Eu, Fe, K, Sc, Sr and Zn were observed for mungbean than the other studied crops. Furthermore PLI (pollution load index) values are greater than one for all the fertilizer applied soil samples except rice growing soil samples which is just below one, showing pollution load in the respective soil environment after the applications of PFs. Moreover, the calculated health risk index (HRI) depicted a greater risk to human health from Al, Pb and Sb as they have HRI greater than one. It is concluded that special attention by environmental authorities should be given to phosphate industry of Pakistan to minimize these hazards and safety measures should be taken to decrease the risk being posed from it.