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Contaminated land assessment and remediation technologies: Hong Kong and US practices

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TITOLO

Tecnologie di valutazione e bonifica di terreni contaminati: le procedure a Hong Kong e degli Stati Uniti

KEY WORDS

Contaminated land, risk assessment, remediation, soil quality standards

PAROLE CHIAVE

Terreni contaminati, valutazione del rischio, bonifica, suolo, standard di qualità

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Summary

The risk assessment is the core of the contaminated land investigation and assessment process. The main objective of investigations is to obtain information on sources, pathways and receptors present on or adjacent to a site. The presence of a linkage between these may then constitute a risk, the significance of which must be assessed and is dependent on many factors. In this paper, the fundamental principles and techniques of risk assessment as applied to contaminated land assessment and remediation are discussed. In Hong Kong, the RBRGs have been established in 2007 to protect the health of people who may potentially be exposed to land contaminated by chemicals. The RBRGs were developed for four different post-restoration land-use scenarios. They are intended to be used as site assessment criteria that are appropriate on a stand-alone basis for the majority of sites in Hong Kong, where human health is the only significant receptor that needs to be protected. This new regulatory guideline and the Dutch B levels of the Netherlands are compared and discussed. In addition, the remediation technologies applied for the former Kai Tak Airport are also highlighted.

Riassunto

La valutazione del rischio è il cuore delle indagini e delle procedure di valutazione di terreni contaminati. Il principale obiettivo delle indagini è quello di ottenere informazioni sulle origini, i percorsi e i recettori presenti o adiacenti ad un sito. La presenza di un collegamento tra questi può poi costituire un rischio, il cui significato deve essere valutato e dipende da molti fattori. In questo lavoro sono discussi i principi fondamentali e le tecniche di valutazione del rischio applicate alla valutazione e bonifica di terreni contaminati. A Hong Kong, sono stati istituiti nel 2007 gli RBRGs per tutelare la salute delle persone che possono potenzialmente essere esposte a terreni contaminati da sostanze chimiche. Gli RBRGs sono stati sviluppati per quattro diversi scenari post-ripristino di utilizzo del territorio. Essi sono destinati ad essere utilizzati come criteri di valutazione del sito appropriati su una base indipendente per la maggior parte dei siti a Hong Kong, dove la salute umana è l'unico recettore significativo che deve essere protetto. Questi nuovi orientamenti norma-

tivi vengono confrontati e discussi con i livelli Dutch B dell'Olanda. Inoltre, sono anche evidenziate le tecnologie di bonifica applicate per l'ex aeroporto di Kai Tak.

Results and Discussion

Many human and industry activities, such as car repair workshops, gasoline stations, underground storage tanks, shipyards, and chemical processing plants, etc., often contaminate our land in Hong Kong. Historically, Hong Kong has no locally-derived standards for land contamination assessment. The Dutch B levels referenced in ProPECC PN3/941 – Contaminated Land Assessment and Remediation had been used for many years until 2007. When a site is classified as contaminated based on the Dutch B levels, the contaminated soil and/or groundwater is required to be cleaned up to meet the Dutch B levels. In 2007, the Environmental Protection Department (EPD) launched a new standard, Risk-based Remediation Goals (RBRGs), specifically for Hong Kong for four different types of post-restoration land uses based on the risk to human receptors under local conditions. The risk-based approach means that contaminated land will be managed by consider-

ing the nature and extent of the potential risk it poses as a result of the receptors' exposure to chemicals in the soil and/or groundwater. This basically acknowledges that there is an acceptably low level of exposure to contaminants, which poses negligible risk. The risk levels for protection of public health in HK are: (1) an excess lifetime cancer risk of 1 in 10^6 for carcinogens; and (2) actual intake must be less than the safe dose for non-carcinogens.

However, the establishment of RBRG using a generic model for all sites by assuming that every site has the same soil/hydrogeological characteristics and chemical exposure pattern deviating significantly from the purpose of using risk assessment. In addition, within the 54 Chemicals of Concern (COC) selected, some appear to be less toxic than others. On the other hand, some of the toxic chemicals that are included in the current guidelines are not shown

Table 1 - Comparison of the Dutch B Standards and RBRGs for Rural Residential Area with Respect to Heavy Metal Concentrations

Heavy Metal	Dutch B-Soil (mg/kg)	RBRGs (Rural Residential) (mg/kg)
Arsenic (As)	30	21.8
Barium (Ba)	400	10 000
Cadmium (Cd)	5	7 208
Chromium (Cr)	250	218
Cobalt (Co)	50	1 460
Copper (Cu)	100	2 910
Mercury (Hg)	2	6.52
Nickel (Ni)	100	1 460
Lead (Pb)	150	255
Zinc (Zn)	500	10 000
Molybdenum (Mo)	40	364
Tin (Sn)	60	10 000

Source: Courtesy of Jannifer Kong, ENVIRON Ltd.

Figure 1 - In-situ Soil vapor extraction in couple with air sparging for both unsaturated soil and saturated soil



Figure 2 - Ex-situ Biopile System for some localized hot spots



in the proposed RBRGs. No justification was given to the selection of the COCs and the de-selection of those currently in use. Moreover, in terms of exposure scenarios, only four types of premises are considered (i.e. urban residential, rural residential, industrial and public parks) and it is difficult to clearly separate the use of land. Table 1 shows a comparison of Dutch B standard and RBRGs (for rural residential) for some of the heavy metal concentrations in soil. It appears that the RBRGs is less stringent than Dutch B levels. We should think more carefully about the implication of the RBRGs on the remediation of contaminated lands in future.

According to the report on Kai Tak Development Project Profile reported by Civil Engineering and Development Department, HKSAR in 2006, the former Kai Tak Airport was highly contaminated by total petroleum hydrocarbon (TPH), and benzene, toluene, ethylbenzene and xylenes (BTEX) which exceeded the Dutch B standards (CEDD, 2006). Also the environmental risk assessment modeling results indicated that the estimated risks in groundwater were all within the acceptable risk levels. A decontamination technology screening process was carried out to identify the most suitable technique for remediating the subject site with site characteristics in con-

sideration. Soil vapor extraction in couple with bioventing for unsaturated soil and air sparging for saturated soil/groundwater were finally used for the subject site (Figure 1). For some localized hot spots, excavation with above ground treatment using biopile was applied (Figure 2).

Reference

1. Kai Tak Development Project Profile, Civil Engineering and Development Department, HKSAR, 2006.