MONITORING OF COMPOSITION OF LNAPL: ESSENTIAL TOOL FOR THE ESTIMATION OF FREE LNAPL SPECIFIC VOLUMES

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In an aquifer contaminated by LNAPL, it is possible to find different mixtures of LNAPL, characterized by different composition. Indeed, in function of percentage of C_6-C_9 and of C_{10}-C_{30}, it is possible subdivide the type of LNAPL in gasoline (more of 70% of C_6-C_9), diesel (more of 70% of C_{10}-C_{30}) and mixture of gasoline and diesel. Each mixture of LNAPL is, obviously, characterized by different properties such as density, viscosity, interfacial tension that influence the fate and transport of contaminant in groundwater and so the estimation of its volume. Over time, two different models are been developed for the volume estimation of the free phase: Pancake Model and Vertical Equilibrium Model. According to the first one, the migration of LNAPL to the water table and its lateral spreading through the capillary fringe creates a buoyant pool with uniform and constant saturation and so the thickness, measured in the monitoring well, is an apparent thickness (Baldi and Pacciani, 1997; CL:AIRE, 2014; Dippenear et al., 2005). Therefore, it is necessary correct the thickness measured in the well, through factors derived by field test, such as baildown test. This test provides an exaggeration factor, function of the LNAPL characteristics, through which it is possible, known the measured thickness, calculate the real thickness of free LNAPL in the aquifer and then the specific volume. Instead, the Vertical Equilibrium Model assumes that there is not a discrete layer of LNAPL floating on the water table, but that LNAPL can penetrate below the water table and the LNAPL saturation varies with the depth creating a saturation profile (ITRC, 2009; Lundegard and Mudford, 1998). A tool to obtain the LNAPL saturation profile is the LDRM (LNAPL Distribution and Recovery Model) application, distributed by the American Petroleum Institute (API, 2007). This application requires a lot of information about the LNAPL thickness in the well, groundwater elevation, soil properties and LNAPL characteristics as density, viscosity and interfacial tensions in order to display the saturation profile and calculate the specific volume. In order to evaluate the influence of LNAPL composition on this calculation, specific volumes have been estimated using both Pancake Model and Vertical Equilibrium Model. This estimation has been carried out applying in every examined monitoring point characteristics of three different LNAPL composition: gasoline, diesel and mixture of gasoline and diesel. The results showed that a variation of LNAPL composition and consequently of its characteristics, conduct to a sensible variation of estimated specific volume. Therefore, as it can been deduced, knowledge of type of free LNAPL and its characteristics are fundamental both for Pancake Model and Vertical Equilibrium Model. In addition, it has been observed in field, that often the LNAPL supernatant can change over the time, due to dissolution and degradation processes that can occur, with the resulting variation of LNAPL characteristics and its fate. Hence, when a contaminated site is monitored for the evaluation of LNAPL volumes, it is fundamental observe with time, not only the supernatant thickness in the well, but also the compounds constituting the LNAPL, through the sampling of supernatant and its analysis.

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