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Parametric study of the impact of waste pollutants on groundwater: the case of Abidjan District (Ivory Coast)

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Abidjan like numerous African cities is experiencing a significant and uncontrolled population growth. The annual growth rate is estimated at 3.99% by the National Institute of Statistics. This rapid population growth also generates growing needs in general and especially for drinking water and economic activities. In the District of Abidjan, groundwater comes from the Mio-Pliocene age aquifer called "Continental Terminal". This unconfined aquifer is the main source of water supply. Its lithology consists of four levels. Actually only the two upper levels outcrop and constitute the main part of the Continental Terminal aquifer. Some recent studies report a potential overexploitation and pollution of Abidjan groundwater (Jourda, 1986, Kouame 2007, Deh, 2013). This deterioration in water quality could be due to the release of domestic and industrial waste water, pesticide and fertilizer from crops and toxic waste sites containing high doses of organochlorines, of hydrogen sulfide and sulfides. This risk is also linked to the economic activities such as car workshops, gas stations and the sand exploitation in the lagoon. To observe the likely evolution of such contaminants in the subsurface and we developed hydrogeological models that couple groundwater flow and transport with FEFLOW software. The model is composed of a sandy layer where two constant hydraulic heads of 55 m and 0.2 m are imposed on the north and the south respectively. We carried out grain size analysis of some samples (E2, E3, E4, E5, and E6) which shows particle size ranging between 0.0001 mm and 8 mm. This grain size analysis performed by sieving underwater and laser indicates that these five soils are: loamy sand with traces of clay and gravel for E2 and E5; Sandy loam with traces of clay for E3; Sand with traces of clay and gravel for E4 and Sand with traces of silt and clay for E6. Their porosity and average values of permeability coefficient K measured in the laboratory range from 0.2 to 0.4 and 2.9E-8 and 2.48E-5 m/s, respectively. These values of permeability are low. They were therefore multiplied by 10 in order to calibrate the model. This suggests that the environment of deposition of the sands is heterogeneous with coarse sand channels in places as it can be expected in such lagoon environment. The result of the model simulation in steady state indicates the groundwater flow direction (North-South) and the approach of pollutants plumes to some well fields after 20 years.

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