Coal-Ash Pond Management: Studying Groundwater Flow Using Darcy's Law

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Thermal power plants generate coal-ash, a bi-product of combustion, which is drained in a liquefied form into man-made ponds, called coal-ash ponds. These coal-ash ponds contain dangerous chemicals (lead, arsenic, etc.) which can cause many problems in human beings. In defective/aging coal-ash ponds, there is risk of these chemicals leaching into the ground water, which flows into surface water. Coal-ash ponds in poor conditions have caused problems in the United States such as the Kingston Fossil Plant Spill in Tennessee and dangerous coal-ash pond near Herrington Lake, Kentucky. Darcy's Law states that the rate of contaminant flow is dependent on the hydraulic gradient of the contamination point as well as the mass of the contaminant. The rate of contaminant flow via groundwater is studied from various contamination points along the path of the flowing groundwater. In another test, the rate of contaminant flow is also studied for varying mass (volume) of the contaminant from the same contamination point. It is hypothesized that the rate of contaminant flow increases as the hydraulic gradient increases. It is also hypothesized that the rate of contaminant flow increases as the mass of liquid increases. Based on the results, it was concluded that the lower the hydraulic gradient is, the safer the coal-ash pond is in case of leakage of contaminants, since it takes longer for the contaminants to reach the river via groundwater. Based on the results, it was also concluded that the he lesser the contaminant volume was in the leaky landfill, the longer it took for the contaminant to reach the river making it safer for the environment. Based on the experiment, recommendations were drawn for coal-ash pond construction and management for environmental sustainability.

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