ENVS4450 Coursework - Water

Part A - Rhine

In 1986, a catastrophic fire broke out in a chemical warehouse in Schweizerhalle, a suburb of Basel, Switzerland. Hearing the sirens that blared during the night, residents of Basel thought that WW III had broken out. Unfortunately, the water used to put out the fire broke the dike surrounding the warehouse and tons of chemicals were washed into the Rhine River which was close to the warehouse. The principal toxic component was the insecticide disulfoton ($C_8H_{19}PS_4$) [CAS 298-04-4]. The following data are relevant to the incident:

amount released in the spill, 3.3 metric ton (1 ton = 1000 Kg)
mean flow velocity of the Rhine at Schweizerhalle, 1.0 m s^{-1}
mean depth of the Rhine at Schweizerhalle, 5.0 m
width of the Rhine at Schweizerhalle, 250 m
duration of the spill, 12 h

1. Calculate the volumetric flow rate (discharge) of the Rhine River in m^3 s^{-1} and L s^{-1}.

2. Calculate the volume of water that flowed during the incident.

3. Estimate the concentration of disulfoton in the contaminated river water in µg L^{-1} and ppb.

4. Comment on the biological consequences of the accident. Useful data on the toxicity of disulfoton can be found at the EXTOX Web site.

5. The flow at Loblith, close to the mouth of the Rhine and 700 km downstream from Schweizerhalle, is 2300 m^3 s^{-1}. When the polluted plume reached Loblith, the concentration of disulfoton was 2.7 µg L^{-1}. Was dilution a major source for the reduction of the disulfoton concentration or were other factors responsible? Briefly discuss.

Part B - Danube

It has been described as the worst disaster since Chernobyl (Cunningham, 2005). In 2000, a catastrophic accident at the Baia Mare facility in Romania released cyanide mine tailing waste into the Danube River. The principal releases were cyanide and heavy metals. The following data are relevant to the incident:

amount of cyanide released in the spill, 50-100 metric ton (1 ton = 1000 Kg)
plume length 60-70 km
plume velocity 2.1-2.4 km h^{-1}
distance to Hungary 70 km

1. What is the percent by weight of gold in Romanian ore? Why was a chemical process employing cyanide used to extract silver and gold at Baia Mare when a physical process has historically been used for mining?

2. What is a lixiviant? Discuss the chemistry involved in using cyanide leaching gold recovery (CLGR) extraction process.

3. What were some of the engineering faults (construction) associated with the disaster? Include a discussion of how the meteorological conditions affected the design of the plant.

4. Why is there a concern that levels of the chemicals used in leaching are tested for under alkaline conditions? Give a specific example.

5. Why are baseline data important? The author states that there was no baseline data, is this true. How might an estimate of the baseline be derived?

6. Why is cyanide considered less environmentally damaging than heavy metals? Describe some of the effects of the heavy metals that are a part of the leaching process.

7. Korte *et al.* (2000) suggests that the CLGR process is unsustainable and a replacement technology is needed. What are some of the measures they suggest as an interim measure to control pollution from such sites?

8. Why did the story take 2 weeks to appear in Western media?

9. How did the levels of cyanide and heavy metals compare between Hungary and Romania? Why were environmental effects of pollutants difficult to measure in the Tisza River (Hungary)?

10. According to Perrow, what is the difference between an incident, an accident and a catastrophe? Discuss the pros and cons with using this framework from an environmental perspective.