BSc Stage 3 Degree Examinations 2018-19

Department:
Biology

Title of Exam:
Bioremediation

Submission deadline:
Monday 13th May 2019, 12pm

- Answer the question provided.
- Your essay must include an abstract of not more than 250 words
- Your essay should not be longer than 2,000 words (excluding the abstract and references), longer essays will be penalised. Please refer to the Departmental WEB pages for penalties on extended essays
- Your essay should be submitted as a Word document (.doc or .docx) via the VLE.
- Please refer to Departmental WEB pages for late submission penalties
This question explores the contamination and bioremediation of a hypothetical former munitions manufacture and storage site. You are being asked to investigate the possibility of using bioremediation to treat this site.

The site is a former large munitions factory that was located in a remote part of the NW of England. Originally built and operated during World War 2 the factory was subsequently closed but some parts of the site continued to be used to store high explosive ordnance, initially in the open but later in temporary buildings. The site was finally used in the disposal of unwanted munitions before being closed in the late 1980’s. At this time the buildings were then removed and the site was left to return to nature.

The whole sited occupies a plot approximately 1000 m x 1000 m and is divided into 7 separate “zones” which are each approximately 100 m x 100 m. Each zone was originally used for different purposes e.g. Manufacturing explosives such as TNT or RDX, filling shells or producing Cordite (a propellant in small arms munitions). Each zone was protected from the others by earth banks approximately 20 m high which were designed to contain explosions in the event of an accident.

The site now consists of the remaining earth banks, some concrete hardstands (where buildings were previously erected) along with roads connecting them. Nature has partially reclaimed the site with the resulting vegetation being scrubland. The soil below the site is a quite heavy clay and the water table is relatively near the surface (approximately 2m below the surface). The whole site is in a natural depression resulting in limited groundwater flow.

The site is now being redeveloped for industrial use. Initial site surveys have confirmed that a range of pollutants have been found on the site. Some, but not all the zones are contaminated. These pollutants are different in different parts of the site. These are as follows

**Zones 3 and 6** contain substantial concentrations of the explosive RDX (in the range of 0.8-1.9 g kg\(^{-1}\)) which has been detected in the surface soil (top meter) in one of the zones. **Zone 4** has been found to be heavily contaminated with TNT to a depth of approximately 20 meters below the surface. It is estimated that there is approximately 80 tonnes of residual explosive present in the site. **Zone 7** sits over a plume of Toluene contamination containing approximately 4 g of Toluene per kg of soil. This material is primarily in the vadose zone but is also, to a limited extent, in the saturated zone. **Zones 1, 2 and 5** show no contamination.

Critically evaluate which bioremediation technologies could be used to deal with this contaminated site with particular emphasis on the relative merits of the range of options that are available.