Tuesday, April 26, 2016
Stream 2A - Education and Research in the Field of Sustainable Remediation
Location: Level 2, Salons 4&5

9:00 am – 9:20 am

Eutrophic Lake Remediation by Using Natural Dolomite Rock to Immobilize Phosphorus from Water Columns and Sediments

Boris Constantin and Rosa Galvez-Cloutier
Laval University

The objective of the presentation is to report the results of batch tests and sediments incubation experiments related to eutrophic lake remediation using natural dolomite rock to immobilize phosphorus from both water column and sediments.

Abstract

Excessive nutrient release, mainly phosphorus, from domestic and agricultural sources accelerates water eutrophication in rivers and lakes, which causes algae blooms such as cyanobacteria, oxygen depletion, production of cyanotoxins and fish mortality. This leads to water uses loss and poses risk to human health through direct contact and water or fish consumption. Therefore sustainably managing water resources requires, among other things, restoration methods to control eutrophication. According to past studies, this environmental issue affects many lakes within the Quebec region: 23 lakes, monitored between 2004 and 2007, needed nutrient control measures. In 2014, 46 Quebec lakes experienced cyanobacteria blooms. In some lakes the sediments are the main source of phosphorus that diffuses into the water column. Thus the external nutrient loading reduction is not always sufficient and in-lake remediation action may be required to improve water quality. This becomes essential when drinking water sources are at risk. Employing geomaterials as reactive media (i.e., dolomite, calcite) to buffer water pollution is becoming a novel eco-technology in recent years. Applying such eco-technology is becoming relevant in the context of sustainable management of water resources. Recent studies demonstrated that such locally available and natural materials are efficient, low cost, non-toxic and ecologic with minor or no potential impact on the environment, and are physicochemically stable.

In the context of the sustainable remediation of contaminated water bodies (both water columns and sediments) this work investigates application of natural dolomite (CaMg(CO3)2) to immobilize phosphorus in eutrophic lakes. Fine-grained dolomite rock was used to tested the removal of phosphorus by adsorption and co-precipitation in the water column while coarse-grained dolomite rock was tested as a subaqueous active capping of contaminated sediments to prevent phosphorus internal loading. Phosphorus immobilization of the natural material was assessed using batch tests and sediment incubation experiments with water and sediments from an eutrophic lake (Saint-Augustin Lake, Quebec, Canada) to simulate in-situ conditions. The results showed that adequate dosages of fine- and coarse-grained dolomite material enables the reduction of phosphorus concentrations up to 84% and below the eutrophication limit level of 30 µg/L. Final values for pH, conductivity and alkalinity suggest that dolomite application may not cause adverse ecological effects. Adsorption equilibrium data was described by Langmuir model suggesting a monolayer sorption with a maximum capacity of 16.6 mg P/g of dolomite.

9:30 am – 9:50 am

A New Process to Develop Sustainable Best Management Practices in Site Remediation and Redevelopment

James King Henderson[1], Paul Favara[2], Olivier Maurer[2], Laís Trento[3]
[1]DuPont Corporate Remediation Group
[2]CH2M HILL
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The objective of the presentation is to discuss a process that was developed to identify key performance indicators and facilitate their translation into best management practices using a benefit-viability model.

Abstract

Sustainable remediation has garnered attention in the international regions, but its use and application is not well understood nor consistently applied. In response, a prescriptive process was developed for 1) the identification of key performance indicators (KPIs) along sustainability lines (environmental, social, economic), and 2) their translation using a benefit-viability model to identify best management practices (BMPs) that can be implemented in any phase of the a remediation project life-cycle. A case study integrating a remedy that involves both remediation of heavily contaminated source zones and dismantling and removal (D&R) of former

production units is presented, and demonstrates how KPI's can be harmonized with selected BMPs.

Sustainability goals were used to develop KPIs for conservation of natural resources (water, soil, air), minimization of waste and energy consumption, preservation of natural resources and biodiversity, efficient management of finances and tax burden, compliance, and redevelopment opportunities. These KPIs were evaluated for practicability, and matched to BMPs that can potentially be implemented by project teams over the course of site remediation and redevelopment.

A scoring system is used for each project phase to evaluate specific BMPs, and a benefit-viability graph shows those most favoured. This method of scoring and visualization allows for quick and simple identification of BMPs that receive priority focus, facilitating selection of those that will be implemented, as well as communicating the result of the selection process in a transparent manner. In addition to clearly defining how BMPs are selected, the prescriptive nature of the methodology is ideal for use in the international regions as a pedagogic tool that clearly demonstrates how remediation and site redevelopment can be performed sustainably.

This study is a direct outcome of the project presented at SustRem 2014 in Ferrara. We expect at the time of the presentation to report back on how successful this approach is for engaging with local authorities.

10:30 am – 10:50 am

Sustainable Treatment of Perchlorate Contaminated Soil and Groundwater Using Local Resources

Kevin Morris, ERM

The objective of the presentation is to provide a case study showcasing the use of local resources for site remediation and repurposing the area that has been remediated eliminating the need for the site to move in to undeveloped areas of the facility.

Abstract

Multiple releases of perchlorate from a process building occurred over a period of approximately 50 years at a small manufacturing facility in the Midwest. Perchlorate had impacted both shallow soils and groundwater at the facility above state recommended guidance levels with concentrations in groundwater as high as 1,100 µg/L and soil at 28,000 µg/kg. A phased sustainable remedial approach was determined to be the most comprehensive solution to address the perchlorate source area and reduce perchlorate concentrations in soil and groundwater.

The phased sustainable remedial approach included the following; establishing an in-situ injection biobarrier in groundwater, decontamination and demolition of the process building and finally, shallow soil-mixing in the former building footprint to introduce an electron donor/carbon source to generate an in-situ bioreactor. The first phase involved installation of the biobarrier immediately down gradient of the process building in August of 2010 to assure that the reducing conditions and carbon/electron donor was introduced to groundwater prior to beginning the soil remediation phase. The injections were conducted starting at approximately 23 feet below ground surface (bgs) (at the top of the aquitard) up to seventeen feet bgs. Two thousand gallons of a five percent emulsified vegetable oil solution (100 gallon solution injected into each point for a total of 1,500 gallons of ESO in a solution of 30,000 gallons). The next phase included the decontamination and demolition of the process building that was conducted in September 2010. The final phase was conducted immediately following the decontamination and demolition of the building that included introducing an electron donor/carbon source into the soils to stimulate the microbial degradation of perchlorate. Approximately 12 yards of hardwood mulch and municipal yard waste, obtained locally, was mixed into the top 48 inches of soil over an area 30 feet by 30 feet just inside the footprint of the former building. Drip irrigation lines were then placed in the furrows created by the soil/mulch tilling to introduce 12,000 gallons of a 1% solution of calcium magnesium acetate as an additional water-soluble electron donor/carbon source.

Perchlorate in groundwater has reduced from 1,100 µg/L to < 10 µg/L in the performance monitoring well immediately downgradient of the biobarrier. Perchlorate in soil reduced from an average of 19,000 µg/kg to an average of 50 µg/kg in six months. These significant reductions in perchlorate concentrations observed in both groundwater and soils have met the remedial goals and have facilitated the request for closure of the site under the State voluntary remediation program in the fall of 2014. The sustainable remedial strategy included minimal low-carbon footprint subsurface injections and shallow soil mixing with a locally obtained carbon source that required no additional energy expenditure and minimal monitoring over the three-year remediation program. No further action is currently being negotiated with the state regulator for both soil and groundwater. The location of the remedial action has been repurposed as a recreation area by the facility.

11:00 am – 11:20 am

Integration of Risk and Life Cycle Analyses for the Selection of Remediation Options for Contaminated Sites

Renée Michaud, École Polytechnique de Montréal

The objective of the presentation is to discuss the use of life cycle analysis and risk analysis to evaluate primary and secondary impacts relating to the evaluation and selection of remedial options.

Abstract

The impact linked to contaminated site remediation activities may be divided into primary impacts (those that are directly linked to emissions from the contaminated site) and secondary impacts (those that are linked to the remediation activities themselves). More and more, we are seeking to take these impacts into account in the context of realizing what we call green remediation, which aims to avoid displacing the problem of a local contamination to a global impact by minimizing the primary and secondary impacts at the same time.

The life cycle analysis (LCA) is a systematic tool that has already repeatedly imposed itself for the assessment of secondary impacts relating to remediation options. However, the primary impacts are poorly considered by this analysis tool, given the use of assessment models for generic impacts that do not take into account the local specificities of the contaminated sites. The risk analysis risk remains the preferred tool for the assessment of primary impacts. However, when we must decide between various remediation options where some of which have a high primary impact (natural monitored attenuation, in-situ bioremediation) and others having major secondary impacts (excavation and transportation in confined cells, thermal processing), it is difficult to make a wise choice by using on the one hand the LCA for the secondary impacts assessment and on the other hand the risk analysis for the primary impacts assessment given the lack of common unity.

However, certain case studies that will be presented here, have tried to reconcile both tools, particularly by integration with data life cycle impacts assessment models and models specific to contaminated sites. This data specific to sites, similar to those generally used in risk analysis, have been used to establish parameters of life cycle impact assessment models in order to better describe the primary impacts. In these case studies, the risk analysis and the LCA are combined in a way to better target the remediation options that have the least impact on the complete life cycle of the remediation process. Once the assessment specific to the site of primary impacts is integrated, the LCA seems to be a promising tool for the selection of remediation options.