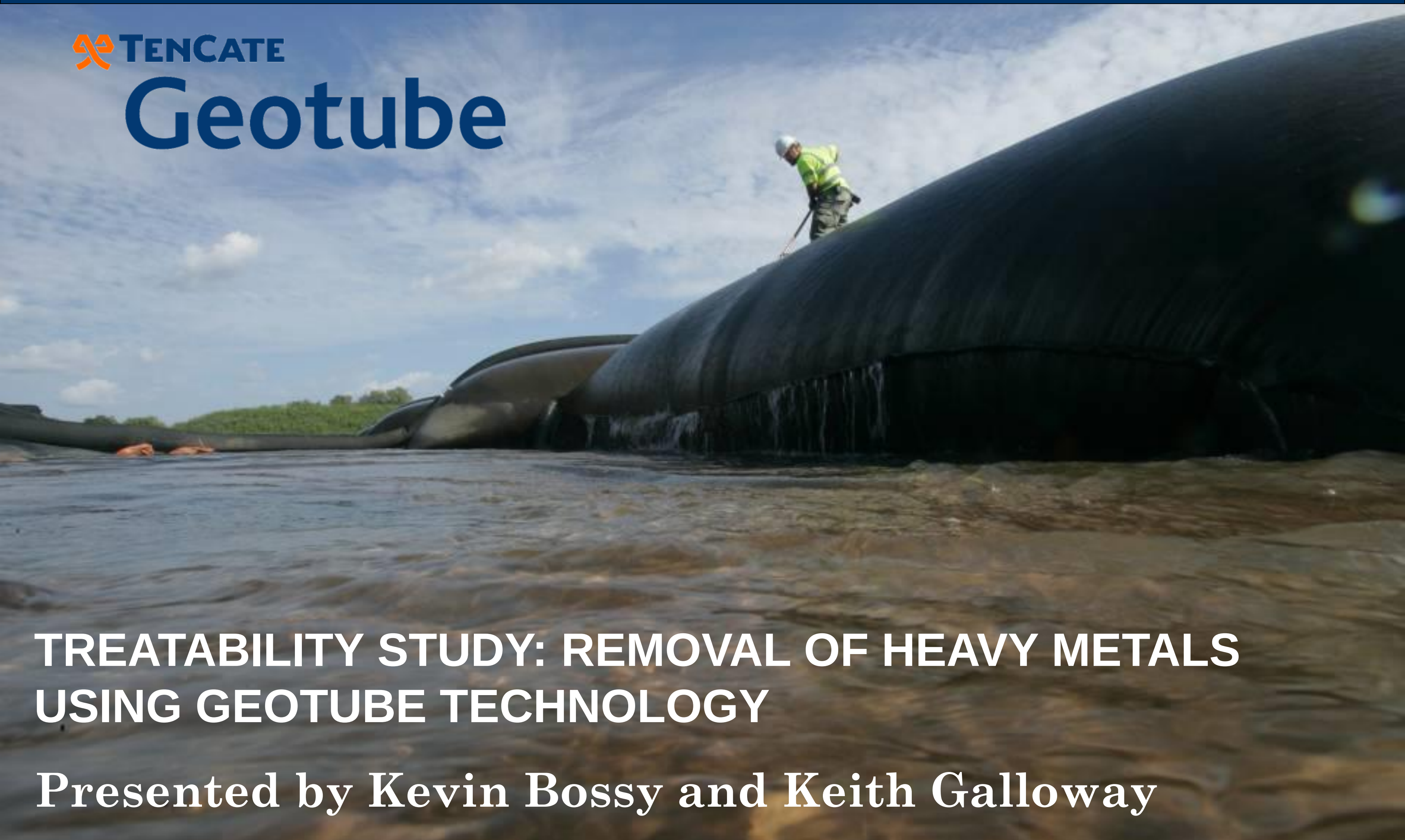


# TREATABILITY STUDY: REMOVAL OF HEAVY METALS USING GEOTUBE TECHNOLOGY

Presented by Kevin Bossy and Keith Galloway

TenCate Geotube

*Bishop Water Technologies Inc.*

# Bishop Water Technologies Inc.

Agents/Distributors for Tencate Geotube® in Eastern Canada

15+ years combined experience

Canada's leader in Geotube® installations for sludge management

. chemical conditioning equipment
. non-pathogenic bacteria and enzymes
. BioCord Reactors and our corner stone technology
. Geotube® dewatering units

Our focus is on the development and implementation of simple, cost effective, environmentally responsible solutions for our clients

## Primary Partnerships

- Tencate Geo-Synthetics North America
- Geo-Dredging and Dewatering Solutions Inc.
- Andrum Associates Inc.
- Marathon Fluid Systems (a division of Sunny Corner Corporation)

# Introduction

- 202 hectare abandoned Mine Site in Ontario
- Used for 100 years
- Gold mining, arsenic, silver refining, and manufacturing of stellate

# Introduction

- Abandoned in 1961, remediation started in the early 1990's
- Due to tailing's run off there was significant contamination of the creek
- Up to 130,000 $m^3$ of material contaminated with heavy metals

# The Challenge


- 2012 pilot study to prove the viability of dredging, conditioning and dewatering highly contaminated sediments, using Geotube® technology

# The Challenge


- Filtrate flow generated from clean-up operations would be too high for treatment at existing Arsenic treatment plant

# The Challenge

- System needed to be developed that would contain the material during various season of operations

# The Challenge


- Contamination ranged from high levels of Arsenic, Cobalt, Copper, Nickel and Zinc along with low levels of radioactivity
- It was extremely important that none of these contaminants were allowed to escape to the environment

# The Challenge


- No permission to take water or permission to discharge
- Lack of water in Young's Creek due to the drought conditions that existed in Eastern Ontario during the summer of 2012
- Material would have to be taken in a solid state and water added to create a slurry

# The Challenge

- Once the sediments dewatered in the Geotube units the filtrate would need to be recovered and recycled
- Water would then be treated for heavy metal removal and discharged to the environment

# The Solution

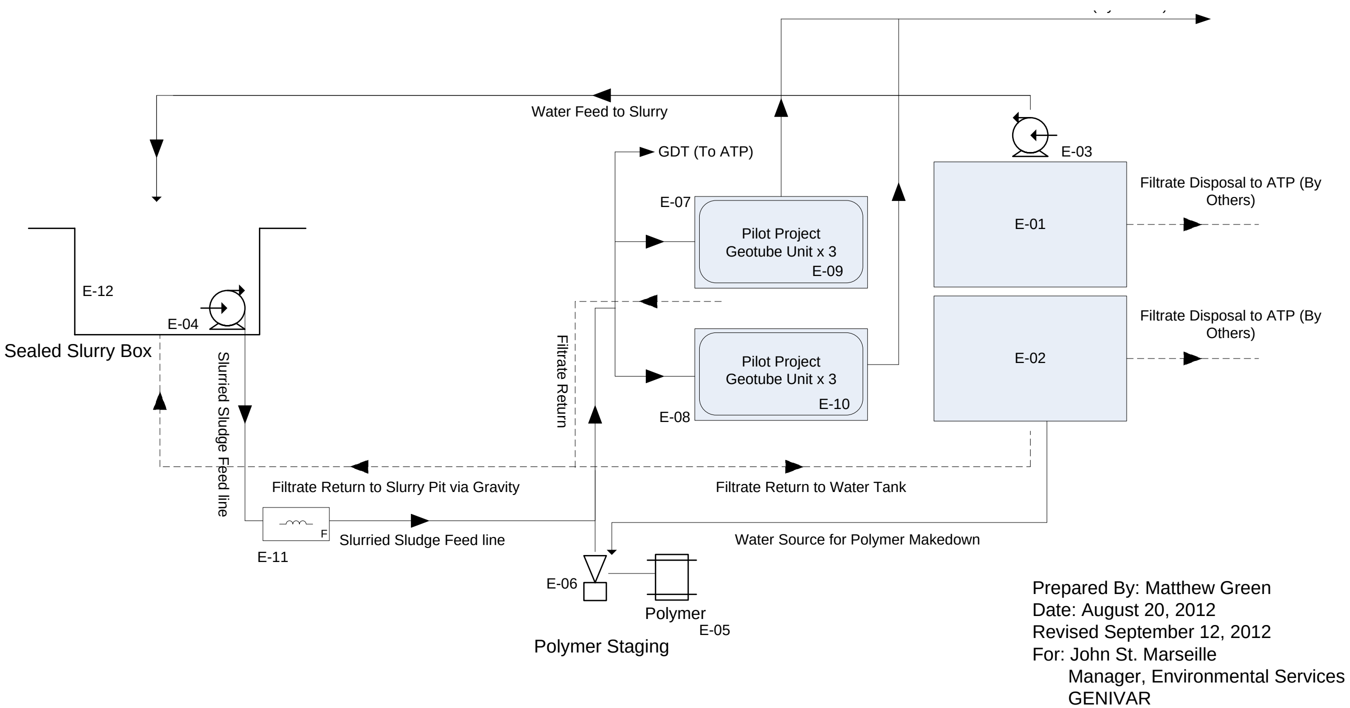



**Figure 3. Process flow of PESE field test**

- Designed and built an on-site pilot system
- Consisted of several sealed roll-off bins that contained MDS Geotube units

# The Solution


- Using fresh water, which was stored in large tanks on site, the sediment was diluted to a suitable consistency and then pumped to one of the Geotube® Units
- On the way to the Geotube® a cationic emulsion polymer was injected to help facilitate dewatering

# The Solution


- Using a small excavator the contaminated soil was brought to a third roll–off bin one bucket at a time.
- Each bucket was tested for radioactivity and a sample was taken for analysis

# The Solution

- The filtrate from the Geotube® Units was collected from the sealed roll-off bins, sent back to the storage tanks and reused as slurry water

# What is Geotube® Dewatering Technology?


- Geotube® dewatering units are geo-synthetic containers, made from high tensile woven polypropylene

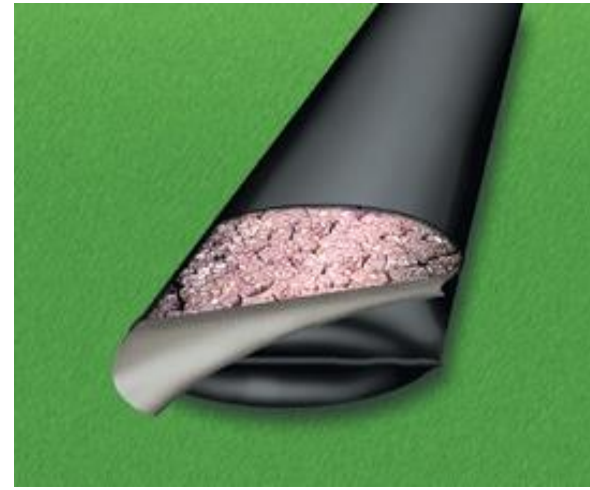
- High flow rate allows residual materials to dewater, while containing solids

# Geotube® Dewatering Technology

## Containment

## Dewatering

## Consolidation



# Advantages of Geotube® Dewatering Units

- High volume containment
- Unlimited storage capacity
- Spread project costs over several years
- Rapid flow through rate
- Drastic reduction in disposal cost
- Minimal capital cost
- Simplicity

# Bench Scale Testing



Raw and conditioned samples

- Various samples ranged from a low of % solids at 7.4% to a high of 20.75% /wt.
- Due to the variety of solids some dilution was needed of the material to ensure optimal flocculation and dewatering

# Bench Scale Testing


- Once optimal polymer conditioning was ascertained the flocculated material was run through an engineered woven dewatering fabric and samples were taken to determine attained solids and TSS of filtrate, and arsenic in the filtrate

# Bench Scale Testing

**Solids and TSS of filtrate**

| YCB08 composite | Raw | Attained 24 hours | Filtrate TSS | Filtrate Arsenic |
|---|---|---|---|---|
| | 5.88% | 24.35% | 36mg/L | 6.03 mg/L |

# Bench Scale Testing

- All samples were dewatered using our GDT test
- Engineered woven dewatering fabric measuring approximately 61cm by 61 cm (2'x 2')
- Up to 94.6 liters (25 gallons) of conditioned slurry can be poured through test bag
- Filtrate/solids captured during the process can be analyzed.

# Bench Scale Testing

## TSS/ as results using Geotextile container

| | Dry Weight 1:1 | Dry Weight 1:2 | Attained solids 24 hours | TSS filtrate mg/L | As Filtrate mg/L | As of Raw diluted mg/L |
|---|---|---|---|---|---|---|
| **Red tailing** | 14.8% | 6.28% | 31.7% | 28 | .715 | 9,410 |
| **Peat/Red Mud** | 10.82% | 5.38% | 23.4% | 70 | .471 | 8,500 |
| **Peat/Organic** | 6.26% | 2.66% | 26.0% | 12 | .210 | 600 |
| **Clay/Peat/Red Mud** | 15.6% | 6.88% | 38% | 20 | .999 | 6,230 |

# Bench Scale Testing

Captured filtrate and solids after chemical conditioning and poured through GT500

# Field Testing


- 130 samples were taken from the designated area on the creek bed each sample was tested for % solids average in situ solids was 55%

# The Operation


- Six mini Geotextile dewatering units were custom fabricated to fit into the 2 watertight dewatering boxes
- Each pilot bag was capable of holding between 5-7 cubic meters of dewatered material
- A self-supported trailer containing the polymer system was deployed to the site

# The Operation

- The polymer system was hooked up to potable water source to make polymer 0.5% solution
- System is capable of processing 1.64 liters of raw polymer per min

# The Operation


- Two 25 cubic meter poly tanks would be put on site and used as a sump for clean/dirty water
- Used for start up slurry and also polymer make down
- Second poly tank would be used as the dirty sump and filtrate from the Geotube® would be directed to this tank.

# The Operation


- This filtrate would also be used to slurry the sediment from Young's Creek
- The dewatering boxes had cam lock fixtures that would allow all the filtrate to be hard piped to the second poly tank

# Filtrate Testing

To determine if filtrate produced by the geotextile tube dewatering technology during the PESE at the Deloro Mine Site could be treated for further reduction of arsenic using a variety of chemical conditioning products.



. Lime Slurry added (target pH 10) and rapid mix for 30 seconds
. Add Coagulant (PAC or Ferric) and rapid mix 30 seconds
. Slow mix for 15 minutes
. Settle for 15 minutes
. Sample from the jar tester using the built in sample port

# Filtrate Testing

## Required

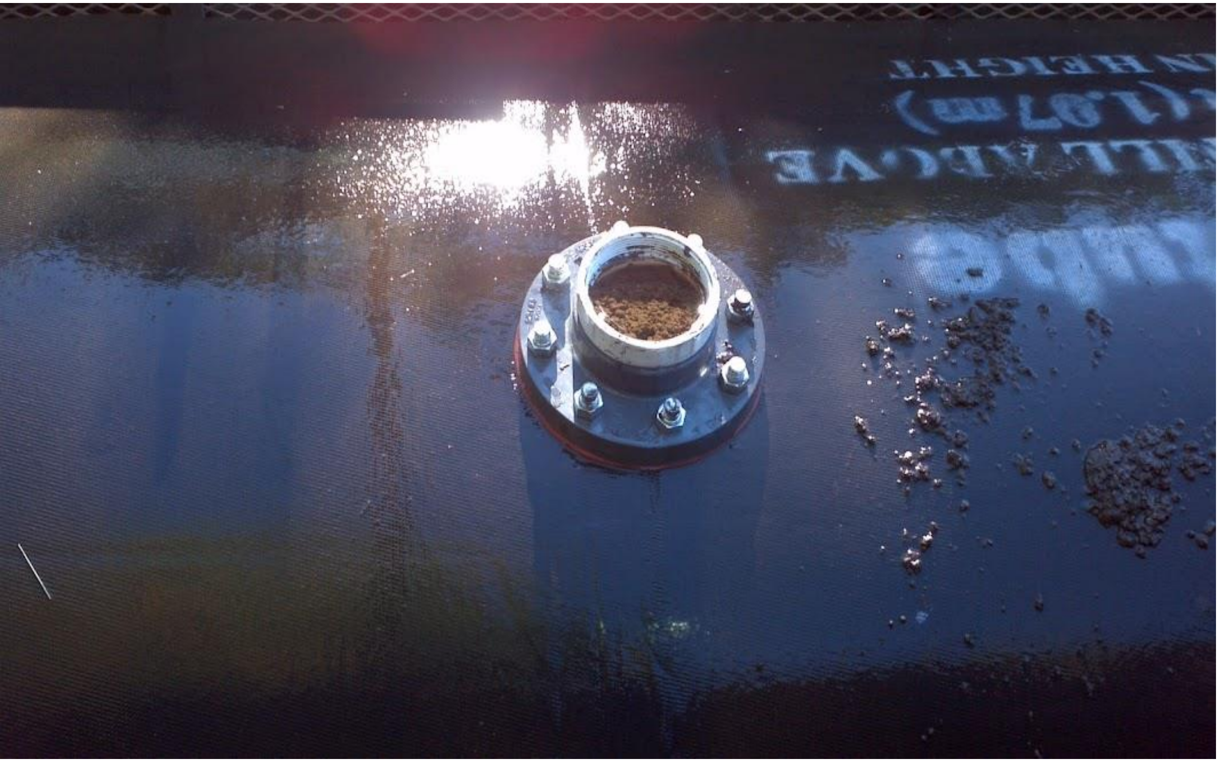
| Parameter | Discharge Criteria |
|---|---|
| TSS | 25 mg/L |
| Arsenic | 0.1 mg/L |
| Cobalt | 49 µg/L |
| Copper | 20 µg/L |
| Nickel | 37 µg/L |

## Attained

| Sample Date | Sample Description | *Temp $^0$C in the field | *pH in the field | Lab pH | Arsenic mg/L | Cobalt mg/L | Copper mg/L | Nickel mg/L |
|---|---|---|---|---|---|---|---|---|
| 10/02/12 | Day 1 Comp Raw | 13.5 | 6.1 | | 0.3140 | | | |
| 10/02/12 | Day 1 Comp LIME only | 13.5 | 9.5 | 10.30 | 0.0154 | .0231 | .0026 | .0126 |
| 10/02/12 | Day 1 Comp 250 ppm PAC | 13.5 | 7.3 | 7.59 | 0.0151 | .0091 | .0017 | .0083 |
| 10/02/12 | Day 1 Comp 500 ppm PAC | 13.5 | 7.0 | 7.61 | 0.0136 | .0191 | .002 | .0144 |
| 10/03/12 | Day 1 Comp 500 ppm $FeCl_3$ | 17.0 | 8.5 | 8.67 | 0.0043 | .0013 | .0001 | .0049 |
| 10/03/12 | Day 1 Comp 1000 ppm $FeCl_3$ | 17.0 | 7.3 | 4.54 | 0.0035 | .205 | .0021 | .059 |

Testing was done on each of the 5 daily composite samples. A series of 6 samples were taken from each of the composites. One raw sample, one of lime slurry only, 250 ppm PAC, 500 ppm PAC, 500 ppm Ferric Chloride and 1000 ppm Ferric Chloride. A total of 30 samples which were submitted for pH and Arsenic and the 4 heavy metals of concern.

# Conclusion



- From a high detected level in the slurry of 9,800 mg/L of arsenic using the geotextile container as a pretreatment with further treatment of the filtrate we were able to bring the level to significantly below that that was required for surface discharge

# Conclusion

- A low level of 0.0080 mg/L was attained from one sample
- This was despite frequent reuse of the water to continue to slurry the material

# References


Golder and Associates (2012). Deloro mine site cleanup project- Young's Creek on-site area, sediment sampling and analysis program, October 26 2012.

Environment Canada (2012). Off-Site Young's Creek risk assessment, Volume 1, Deloro Mine Site Cleanup Project Deloro, Ontario ENVIRON EC (Canada), Inc. Mississauga, Ontario, February 2012

Genivar (2013). Deloro Mines- Youngs Creek Area (on Site Off Site) Design Brief, May 2013

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