Thermal Desorption: An Innovative and Environmentally Sound Means for Remediation of Hydrocarbon Contaminated Soil
Outline

• Nelson’s Background
• Process overview and description
• Factors for success
• Benefits
Nelson Environmental Remediation

• Nelson Environmental Remediation, Ltd. is a Western Canadian based environmental contractor, specializing in soil remediation and contaminated site preparation/restoration.

• Nelson’s unique mobile, thermal soil remediation system is cost-effective, has a predictable timeline, eliminates liability issues attached to a site, and results in beneficial re-use soil.

• Bottom line, we provide certainty!
Nelson Overview

- Nelson’s Corporate Headquarters is located 20 minutes west of Edmonton in Parkland County, Alberta, Canada
Nelson History

- Nelson has done over 40 projects in our 23 year history.

- Nelson has treated over 3 Million tonnes of impacted soils.
  - Our largest site is over 1 million tonnes.

- Thermal desorption is applicable to organic contaminants and generally is not used for treating metals and other inorganics.
What is Thermal Desorption?

- The U.S. EPA currently defines thermal desorption as “a physical separation process” - it is not a form of incineration.
- It is fundamentally a 2 step process
  - Step 1, heat is applied to a contaminated material such as soil to vapourize the contaminants into a gas stream
  - Step 2, the gas stream is treated to meet regulatory requirements. In our case the volatilized contaminants are oxidized
- Thermal desorption is an Ex-Situ process
- Thermal desorption is applicable to organic contaminants and generally is not used for treating metals and other inorganics.
Thermal process overview

http://nerglobal.com/process-scroller/
Generic Thermal process overview

Contaminated Material Feed → Thermal Desorption → Treated Material → Off-Gas Treatment → Residuals → Release to Atmosphere

Step 1: Heat Material to Volatize Organic Compounds

Step 2: Condense, Collect, or Combust Vapor-Phase Organic Compounds
Thermal process overview

Thermal Remediation Cycle
Thermal Desorption Unit - (TDU)

1. Belt Weigh Scale
2. Contaminated Soil
3. Rotary Drum Desorber
4. Water and Vapor Emission
5. Dust
6. Bag House
7. Thermal Oxidizer
8. Auger Quench System

Clean Soil
Video demonstrating TDU operations at >500,000 tonne site

Contaminants heated to 870+°C, O₂ then added
→ 1 second chamber retention time yields destruction efficiency >99.99%

Stack Emissions: 83-85% N₂; 7-8% O₂; 7-9% CO₂
Emission Particulate Control

Gasified contaminants flow to Bag House ➔ Dust particulate filtered and returned to soil stream
Treated Soil Characteristics

• The clean recycled soil is re-hydrated to between 8 to 10% moisture

• Available for beneficial re-use
  – provides for smooth backfilling and excellent compaction.
  – Rehydrated and cooled soil can be utilized to backfill the excavation at the site.
Examples of treatment effectiveness

• VOC example
  – Train derailment
  – Styrene spilled.
  – Mixture of peat and sand
  – Criteria
    • 0.6 mg/kg Styrene

• Pipeline break in U.S.
  – Raw Bakken crude spilled in North Dakota, USA
  – Large volume of soil impacted
    • >500,000 tonnes
  – Glacial till
  – Criteria
    • 200 mg/kg TPH (C11 to C36)
    • Non Detect C6 to C10
Factors for Success

- Location and regulatory issues
- Site specifics
- Utilities available
- Soil type and volume
- Contaminant Characteristics
Location and Regulatory

• Local jurisdiction's **soil remediation criteria.**
• Air emission guidelines and permits required
• Employee visas, health, safety, logistics
• Local labour capability, can staff requirements be hired locally and trained,
• Local supplier capability, heavy equipment (Caterpillar etc.), equipment parts and repairs,
• Mobilization and demobilization logistics, costs and timing.
Site Specific Concerns

• Size and shape, preferably a 100m x 100m pad but less can work if site specifics allow.
• Distance to neighbours, residential or industrial. 24-hour / 7-day operation is critical to minimize costs.
• Site security.
• Access for services, utilities, deliveries etc.
• Compaction for plant footing, site drainage, etc.
• Weather, altitude, humidity etc. can affect TDU settings and subsequent production.
• Ground water table?
Site Layout
Utilities Availability

• Burner fuel can be natural gas, propane, diesel etc. (require 30-70 MMbtu/hour equivalent depending on TDU spec).

• Diesel is always required for peripheral soil handling equipment. (approx. 700-1500 Litre/day).

• Electricity is required at 480 volt 250-700 amp (generator provided if power not available).

• Clean water is required for soil rehydration. (aprox. 100 Liter/Tonne of soil processed)
Soil Characteristics

- Soil type dictates equipment selection for soil handling as well as TDU configurations and desorption rates.
  - Sands and coarse grained materials desorb more easily than fine grained soils.
  - High organic soils may contribute combustibles and energy

- Moisture content. Directly affects throughput, fuel consumption and soil handling requirements
  - Additional site room to allow drying of soil may create major savings of time and fuel.
  - Costs increase as moisture content level increases due to reduction of production rate. Preferred ceiling is 25%,

- Frost and frozen ground conditions
Moisture

– Moisture Content.
  • The degree of moisture adversely affects operating costs because increased requires more fuel.
  • Directly affects throughput, fuel consumption and soil handling requirements
  • Moreover, the added volume of water vapor in the process off-gas can result in a lower production rates, because the water vapor must be handled by the downstream treatment equipment along with the balance of the off-gas and the desorbed contaminants

– Remedies
  • Additional site room to allow drying of soil may create major savings of time and fuel.
Contaminant Characteristics

- The concentration of contaminant and nature of the contaminant.
  - Wide range of hydrocarbons or refined product with narrow spectrum?
  - Distribution of the carbon chains C11-C100+ has a large affect on process.
  - Carbon chains beyond C60 require special operating parameters
- Is there potential for compounds present that lab analytical missed?
  - Asphaltenes, tars, etc.
  - evidenced only by energy values or carbon loading of the soil.
- Do chlorinated compounds exist?
  - may require additional gas scrubbing equipment.
- Do non-organic contaminants exist that can react to the thermal process? (mercury, lead, magnesium, sulphur etc.)
Benefits of Using Thermal Desorption

• Safely recycles contaminated soil from liability to valuable asset for beneficial reuse.
  – Original soil from site is preserved
• Eliminates Liabilities of transportation
• Eliminates sourcing and transportation of clean backfill importation
• Enhanced Community relations
• Cradle to Grave Site management
• Aligns with social responsibility
  – Liability elimination, unencumbered future use
Considerations of Using Thermal Desorption

- Thermal brings cost reductions beyond our price per ton:
  - Reduction in reliance on trucking and a corresponding reduction in liabilities associated with transportation of excavated material and clean backfill.
    - Site traffic reduction and thus increase in site safety. NELSON’s on site thermal solutions significantly reduce truck traffic on your site, thus reducing risk and costs associated with managing truck traffic coming and going on your site, as compared to traditional dig and dump.
  - Onsite Thermal eliminates requirement of sourcing and paying for clean backfill. Thermally treated soil can be re-used as backfill on your site.
  - Significant reduction of lab costs. Lab analytical costs can be significantly reduced through utilization of our services. For example, rather than paying for Rush Class 2 landfill analytical every ten trucks, (e.g. several per day) you only pay for one soil analytical per 24 hour period, or 500 tonne production increment.
  - Alignment with your client’s social responsibility. NELSON's onsite thermal solution provides liability elimination on your property, leaving you with an unencumbered site allowing unrestricted future use.