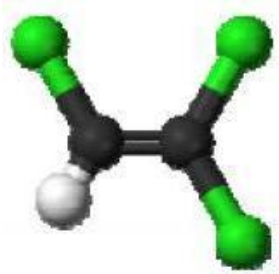

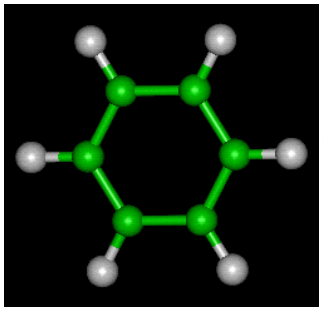

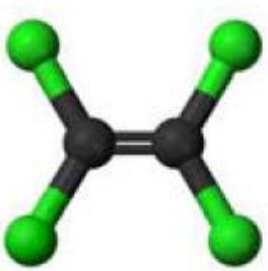


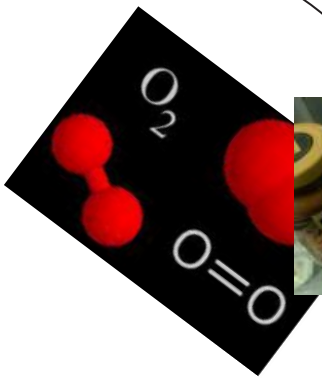



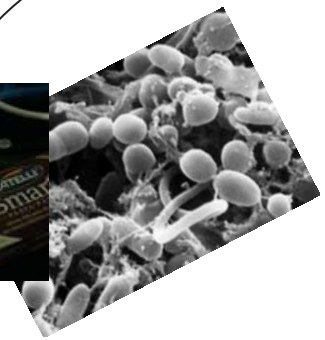


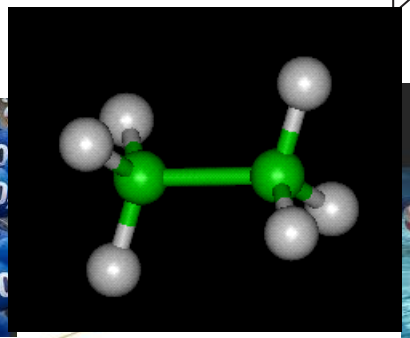

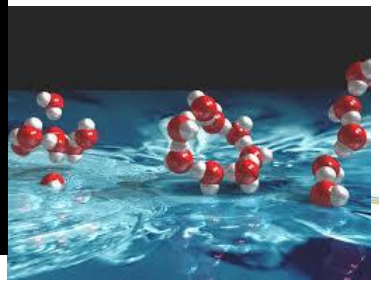

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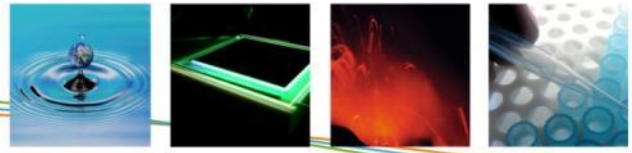


08/11/2011

# MNA: accepted as established remediation technology?

Ilse Van Keer, Richard Lookman, Johan Gemoets

Snowman Network Conference on MNA, Paris 7th November 2011

# MNA MILESTONES

**Claus & Walker 1964**
**Hirsh & Alexander 1960**
**Jensen 1957**

Papers on bacterial decomposition of halogenated aliphatic acids and toluene

**Barker et al. (1987)**

NA of aromatic hydrocarbons

**AFCEE 1992 (USA)**

fuel & solvents

**Protocols-Guidelines**

AFCEE (1995;1996)
ASTM (1997)
EA, E&W (2000)
IAEA (2006)
NOBIS '(1998;2000)
OSWER (1997;1999)
OVAM (2003)
RTDF (1997)
Wiedemeier et al. (1996)

**National Research Project & Discussion Fora**

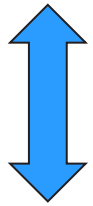
NI: NOBIS-SKB (1995-1999)
GE: KORA (2002)
UK: NNAGS – SIREN (1997-2000)
(EU: Nicole (1995))

**1998**

Flanders: 1st MNA remediation project

**2011**

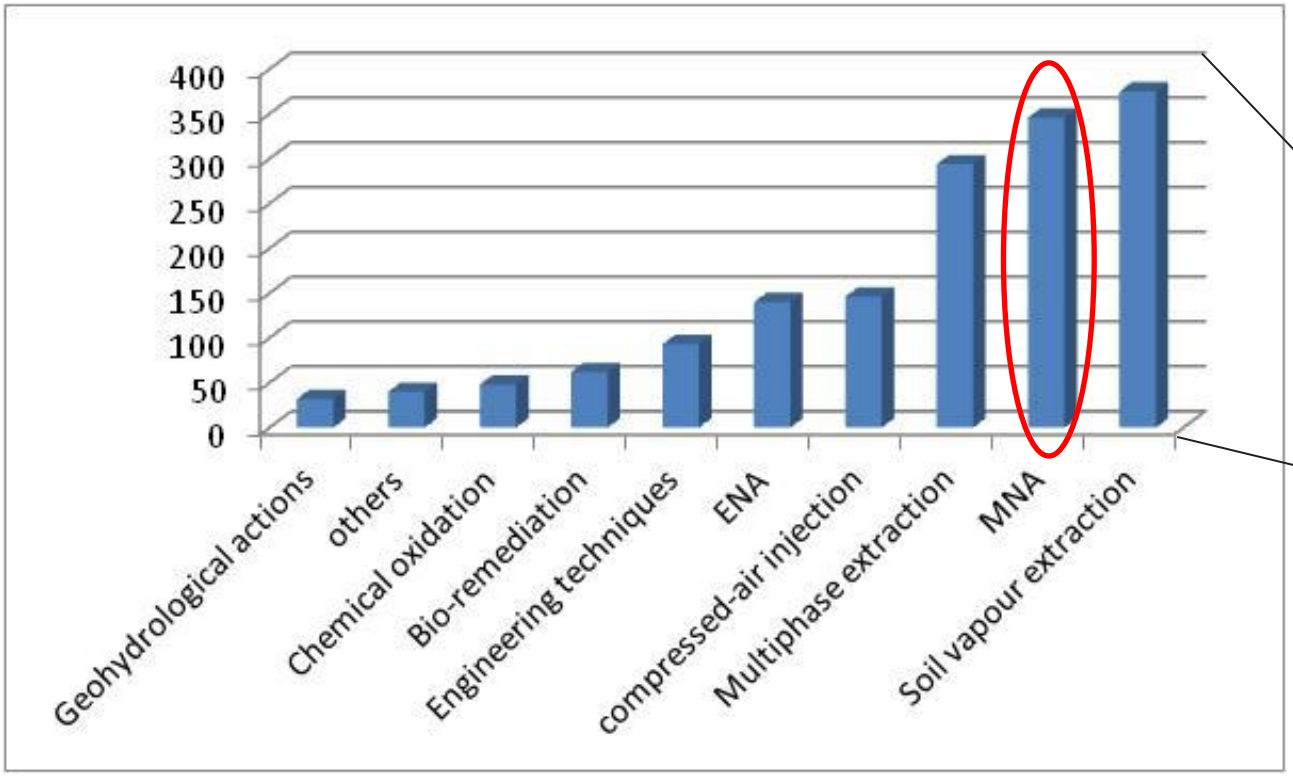
**MNA:**
"accepted" remediation method

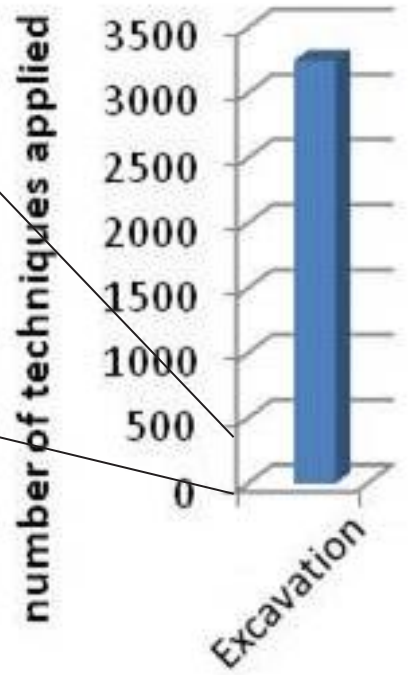


- Challenge in terms of technique & performance
- Fitting into soil policy
- Sociological impact
- Financial & legal applications

# MNA IN FLANDERS

January – June 2011



# (M)NA in Flanders: Code of good practice (OVAM, 2003) – 4 research phases

- **Phase 1**: **screening** to assess the applicability of MNA
  - Feasibility of MNA (detailed conceptual model)
  - Acceptance of MNA
- **Phase 2**: **demonstration** to quantify the *current* performance of MNA
  - Trendanalysis
  - Illustration of chemical processes
- **Phase 3: evaluation - long term analysis**
  - Massbalances
  - Spreading of the contaminants
- **Phase 4**: **validation**
  - Monitoring
  - Evaluation plume length
  - Comparison field data with remediation goals
  - ……

# MNA in Flanders: Criteria for acceptance

» **Adequate monitoring:**
- NA occurs;
- NA will continue to occur;
- NA capable to reach pre-defined remediation goals.

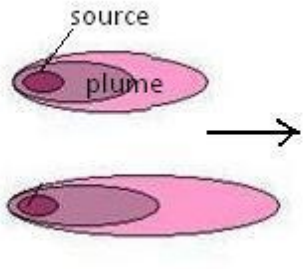
» **"Reasonable" time-frame**
- Remediation goals within a (< 30 years);
- NA process "not excessively long" compared to other options.


» **Regulator must be convinced**
- sufficient and objective data;
- during and after the MNA: protection of receptors;
- no rebound.

» **Back-up remediation strategy**

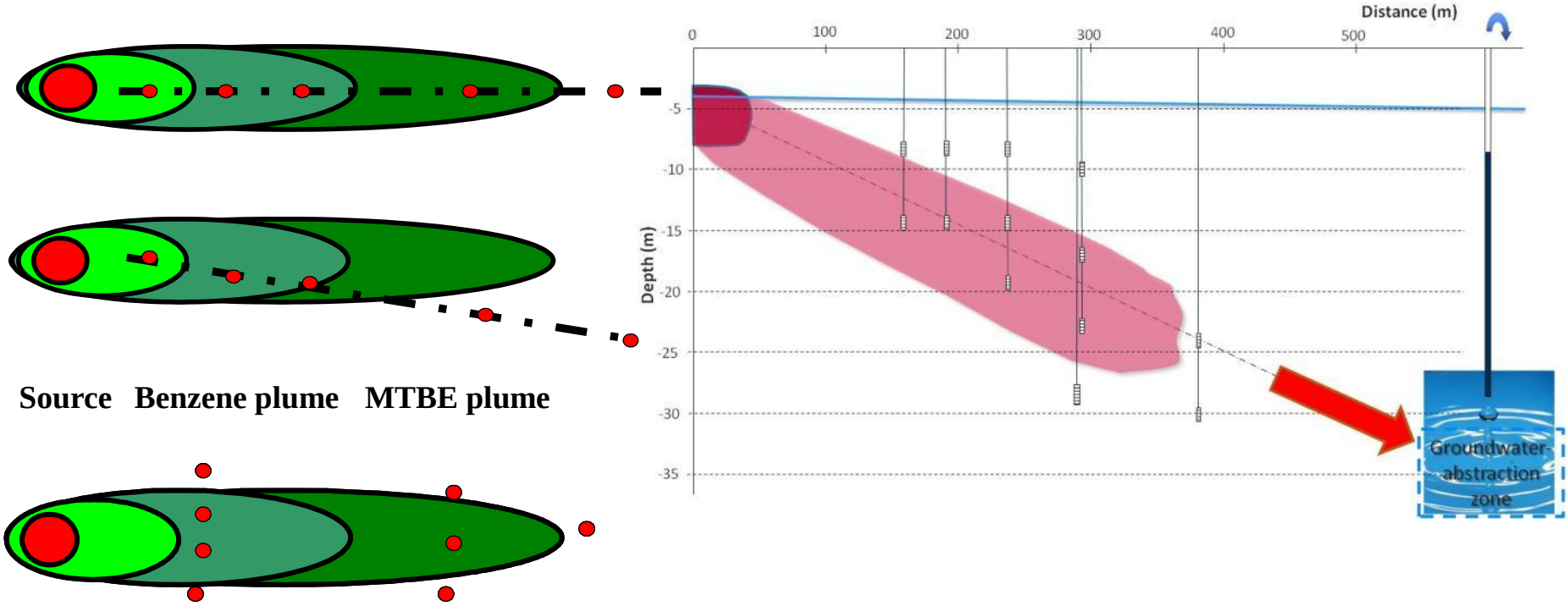
# MNA in Flanders: Rejection


- **Pollution Source:**
  - Not removed
  - Feeding plume
- **Attenuation mechanism :**
  - ≠ Degradation
  - = Dilution
- **Risk assesment (actual ⟷ potential)**
  - Spreading risk – expanding plume
  - Human risk
  - Ecological risks




# MNA in Flanders: Monitoring

- **Decreasing concentration trends**
- **Correctly placed monitoring locations:**
  - Lateraly: right place in XY-lane
  - Along central migration axis at right depth

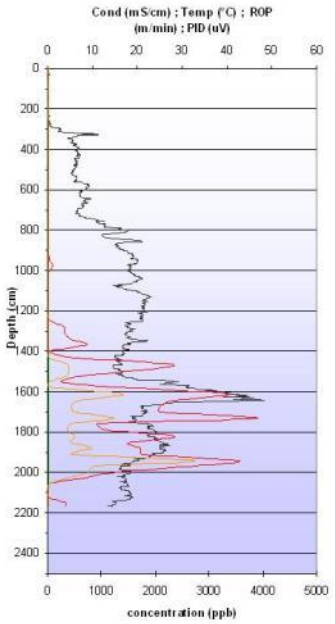


# Screening and validation phase : monitoring
# Classic & Innovative Research techniques

## MIP

### classic

### EnISSA MIP




## Passive Samplers

## Classic soil sampling + oil-water test

## + hydrophobic dyes

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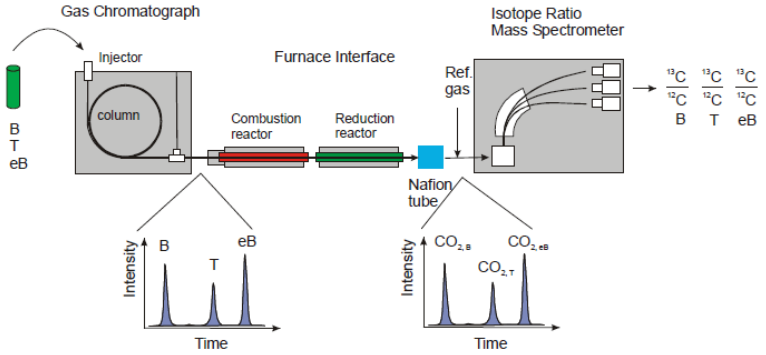
# Monitoring Techniques: cost estimate

| Technique | Euro | Remark |
|---|---|---|
| classic groundwater survey | 1100 | per screened meter (placement of sampling well, analyses, report) |
| groundwater samplers | | |
| . discrete interval sampler | 400 - 700 | depending upon sampler size and length of tubing (sampling depth) (excl. analytical cost). |
| . Enviroflux Passive Flux Meter | 450-900 | per screened meter (materials, mobilization/demobilization, disposal expenses, and analytical services) |
| CSIA | 200-300 | per isotope, per contaminant & per sample |
| MIP | 1500 - 3000 | per day (direct push platform, crew (2p), MIP operating system and detectors.) |
| EnISSA MIP | 130 | per (screened) meter |

# CSIA APPLICATION




- Distinction between source zones
- Identification / semi-quantification of biodegradation

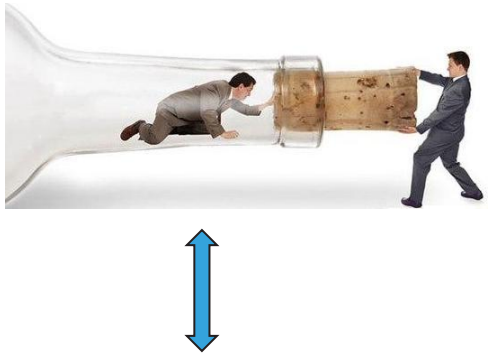
- Differentiation of mixing plumes difficult
- Time consuming analyses
- No standard method available
- Interpretation of data by highly qualified personel

**CSIA ≠ straightforward interpretation ⟷ juridical value of data?**

# Sustainability of (M)NA

- **Depends on**
  - Presence of “the right”chemical / biochemical processes
  - Avalibility of sufficient energy

- **Assesment**
  - Determination of groundwater flux
  - Delineation of mass and distribution of contaminants
  - Indentification of degradation processes
  - Quantification of mass flux of available electron acceptors
  - Quantification of mass flux of available organic carbon
  - Assess the interaction of electron donors and acceptors



Available methods :
. Not always easy to apply (cf. anaerobic sampling conditions);
. Rather expensive;
. Not easy to interprete the results

# MNA processes

| | biological oxidation | | | | |
|---|---|---|---|---|---|
| | aerobic | anaerobic e-acceptor | | | |
| **Parameter** | | **nitrate** | **Fe (III)** | **sulphate** | **CO2** |
| benzene | + | ? | + | + | + |
| toluene | + | + | + | + | + |
| ethylbenzene | + | - | ? | ? | ? |
| m-xylene | + | - | + | ? | ? |
| o-xylene | + | - | + | + | + |
| p-xylene | + | - | + | ? | ? |

+: degradation proven

? : degradation unknown (no references) or contradiction in literature

- : in-situ degradation not illustrated

| | chemical reduction | biological oxidation | |
|---|---|---|---|
| **contaminant** | | **aerobic** | **anaerobic** |
| **PER** | + | ? | ? |
| **TRI** | + | ? | ? |
| **cis 12 DCE** | +/? | +/? | ? |
| **VC** | +/? | ++ | +/? |

| | |
|---|---|
| ?: proces not proven | +/?: proces proven, occurence uncertain |
| +: proces proven, possibly relevant | ++: proces proven, very relevant |

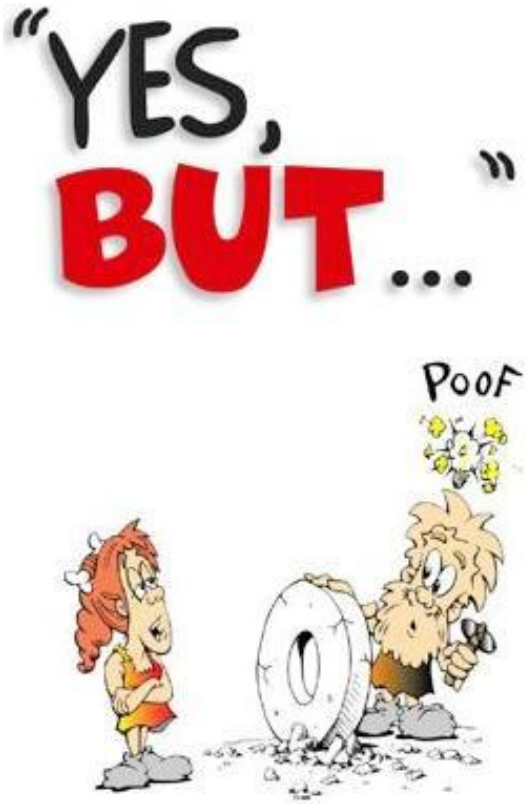
# MNA “established” technology?


- MNA = doing noting – no action approach
- Health protection is needed now
- MNA allow polluters to escape their responsibility
- MNA only benefits the polluters
- Predictions about future plume behaviour are never 100% certain
- MNA slower compared to digging & active pumping

# MNA “established” technology?

- Removed pollution source
- Unremoved pollution source / Stable plume
- Unremoved pollution source / unstable plume /temporary AND no treath of receptor


# MNA “established” technology?




- **High level of knowledge required**
  - Detailed conceptual model
  - Groundwater flow & retardation
  - NA processes known
  - NO treath of receptors
- **High amount of reliable data is required**
  - Monitoring over long period
  - Monitoring in different seasons
  - Statistical relevant
- **Iterative update conceptual model**
  - Evaluation of plume migration
  - Risk evaluation
  - Adaptation monitoring program

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CAH degradation kinetics?
MNA Bottlenecks?
Screening techniques?
CSIA cost effective?
Evaluation of sustainability: how?