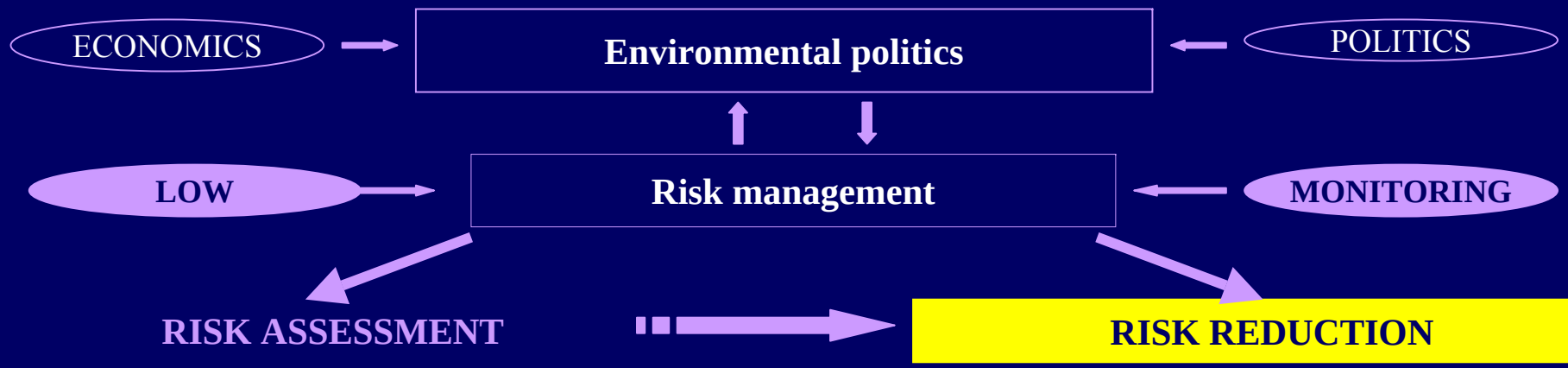
Soil remediation

Risk assessment and risk reduction of chemicals in the environment

II

Gruiz Katalin

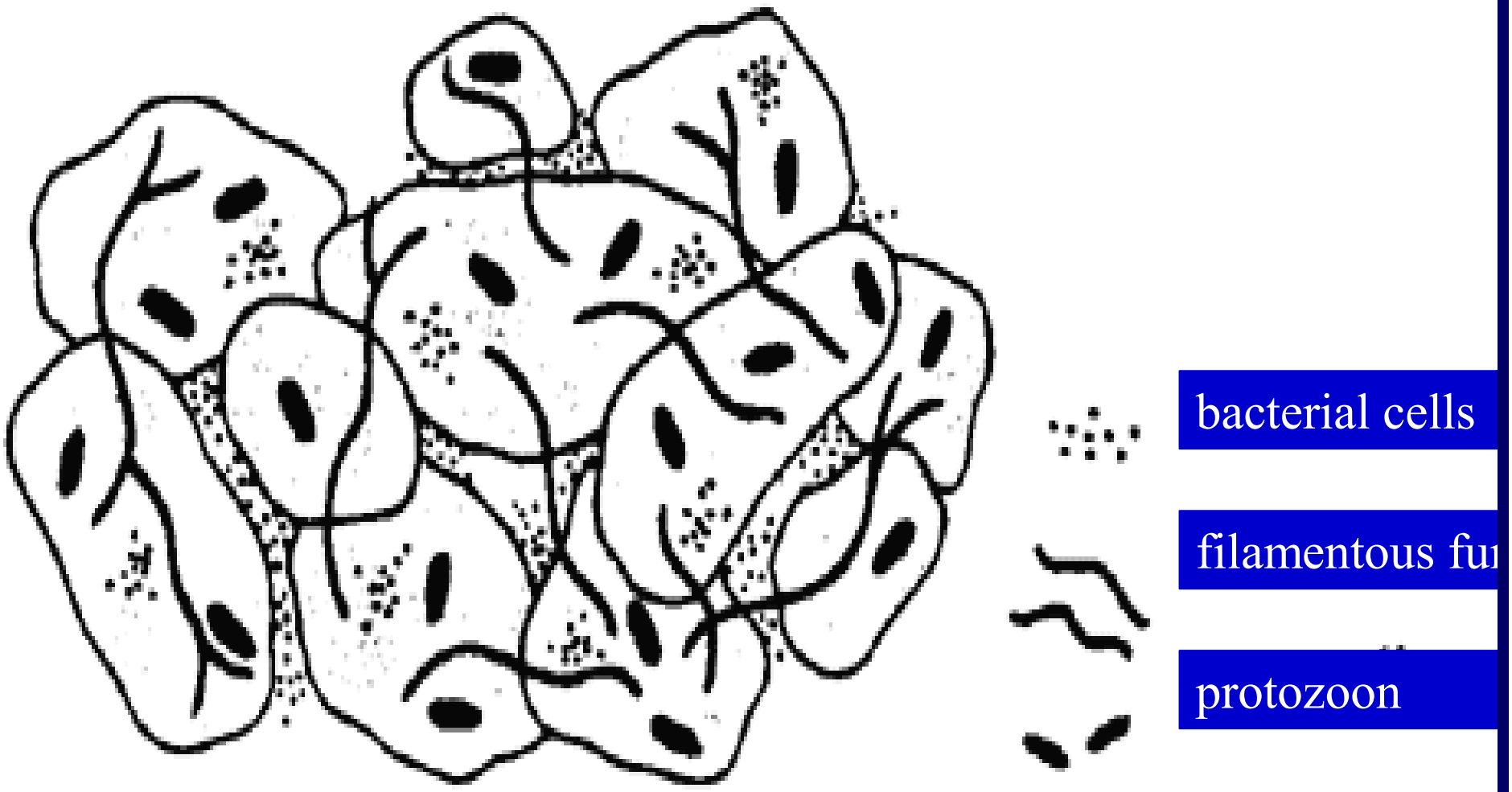
Tools of environmental management



1. HAZARD IDENTIFICATION
2. RISK ASSESSMENT
   - Generic / site specific
   - Qualitative/ Quantitative
   - Ecological / Human health

1. PREVENTION
2 . RESTRICTION
3. REMEDIATION
   - Physico-chemical technologies
   - Bioremediation
   - Ecotechnologies

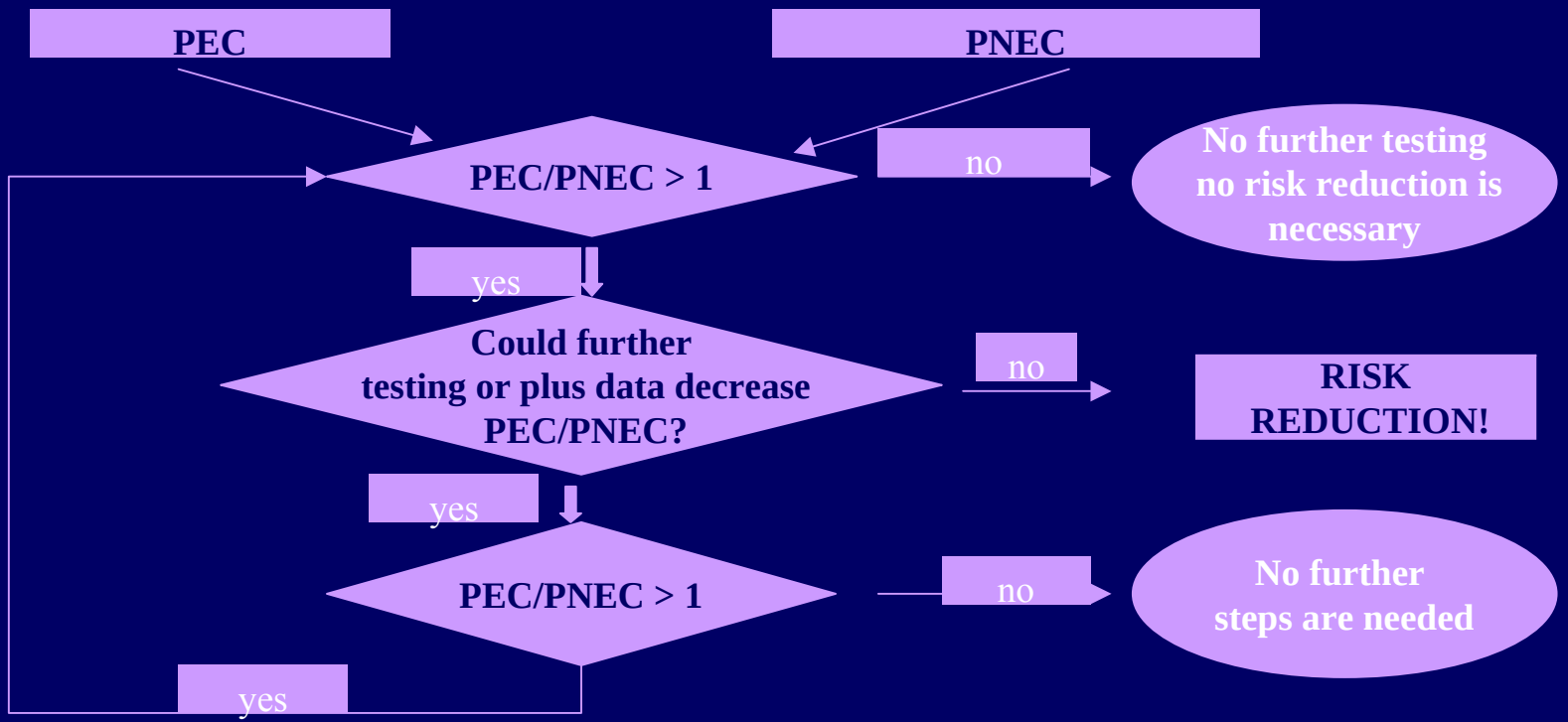
Microbes on the surface of soil particles



Quantitative environmental risk assessment of substances in soil

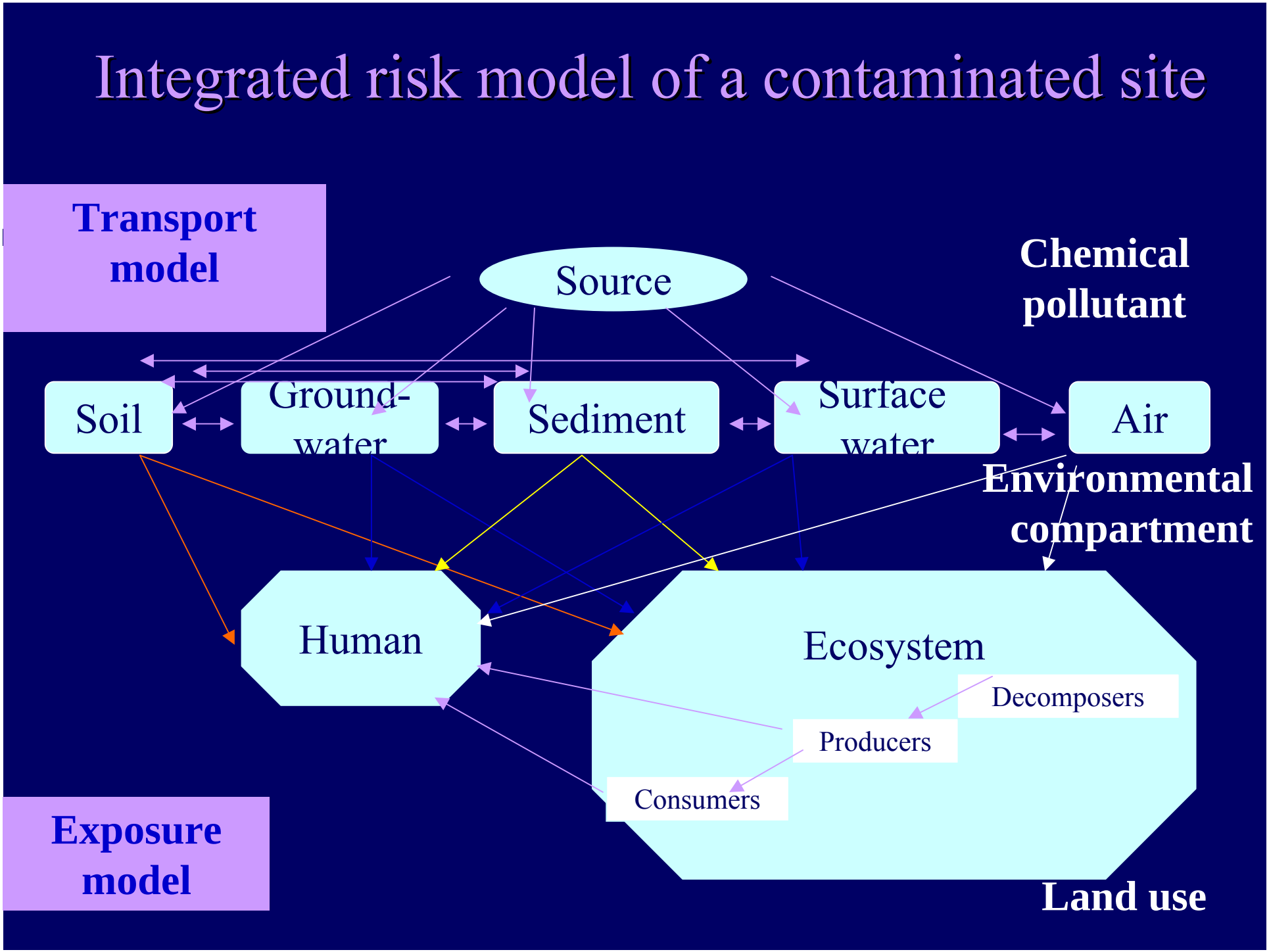
Characteristics of the risk assessment procedure:

- gradual procedure (cost effective),
- iterative
- it uses worth case estimation (pessimistic model)
- it works also in case of lack of data (exclusion)



PEC = Predicted Environmnetal Concentration **PNEC: Predicted No Effect (on the ecosystem)Concentration**

Integrated risk model of a contaminated site



Remediation by mobilisation of the contaminant

Chemical characteristics of the contaminant	Contaminated soil air	Contaminated ground water	Contaminated solid phase
Volatile	Based on biodegradation Soil gas extraction and ex situ treatment	Based on biodegradation Stripping	Based on biodegradation Soil vapour extraction and ex situ treatment
Water soluble	Based on biodegradation Soil vapour extraction and ex situ treatment	Ground water pump and treat, or in situ treatment Based on biodegradation Based on chemical reactions Fitoremediation Active subsurface walls Electrokinetic remediation	Based on biodegradation Bioleaching Soil washing Thermal desorption In situ chemical oxidation Electrokinetic remediation
Sorbable	Based on biodegradation Soil vapour extraction and ex situ treatment	Based on Biodegradation Ground water pump end treat	Based on biodegradation Bioleaching Fitoremediation Chemical extraction Grain size fractionation Thermal desorption Thermal oxidation Pirolyzis Vitrification

Remediation by immobilisation of the contaminant

Chemical characteristics of the contaminant	Contaminated soil air	Contaminated ground water	Contaminated solid phase
Volatile	Isolation Chemical immobilisation	Biological immobilisation Chemical immobilisation	Gas-adsorption on solid phase Chemical immobilisation
Water soluble	Isolation Physico-chemical immobilisation (precipitation, increasing sorption)	Biological immobilisation Rhizofiltration Increasing sorption Precipitation, decreasing solubility Chemical oxidation / reduction	Biological immobilisation Phytostabilisation Increasing sorption Chemical oxidation / reduction Physico-chemical stabilisation
Sorbable		Biological immobilisation Rysofiltration Increasing sorption Precipitataion, decreasing solubility Chemical oxidation / reduction	Biological immobilisation Phytostabilisation Increasing sorption Chemical oxidation / reduction Physico-chemical stab. Vitrification: Ceramic production

Bioremediation

I. Based on biodegradation

The biodegradation of the contamainants in the soil or in the ground water is ensured by the genetical and biochemical potential of the soil microbes.

The pollutants get into the element cycle on the same pathway as the natural organic matter.

Type of biodegradation: Associated with energy production
By co-metabolism (no energz is produced)

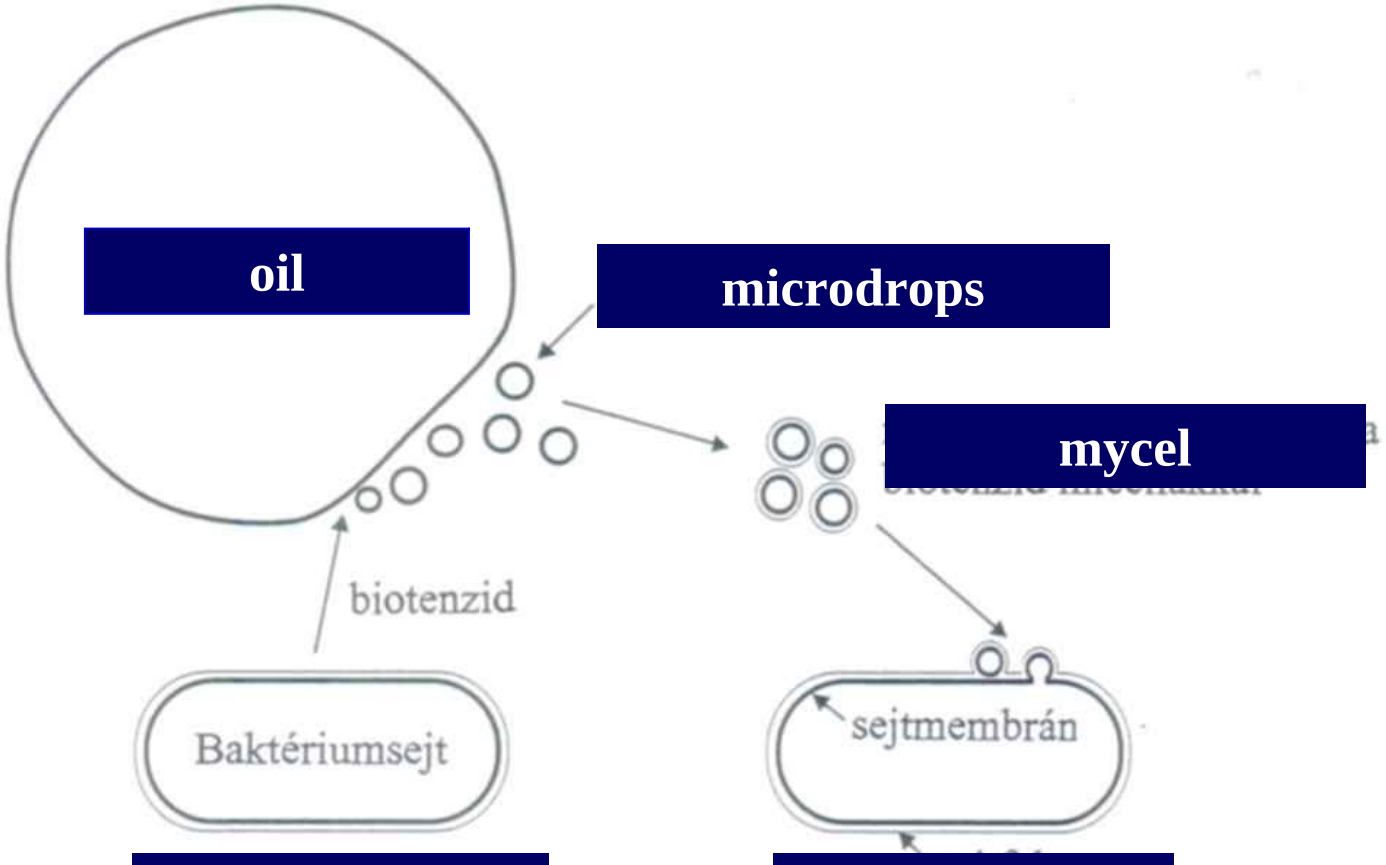
Depending on redox-potential: aerobic / facultative anaerobic / anaerobic

Complete mineralisation or partial degradation followed by humus-production.

II. Based on microbial stabilisation: irreversible incorporation of organic compounds into the humus or into inorganic compounds (metal-sulphides)

II. Bioleaching: leaching from soil as a result of microbial activity: metal extraction

Natural tensides



Phytoremediation

Phytoextraction

From soil: by hyperaccumulating plants, in their stem ot leaves, high yield of biomass, burning, ash treatment, recycling in some cases

From ground water: by the rhysosphere of plants like wilow or reed

From surface water: rhysofiltration, living machines

Phytostabilisation

- **Growing resistant species: physical stabilisation by plants**
- **A combination of chemical and phytostabilisation**

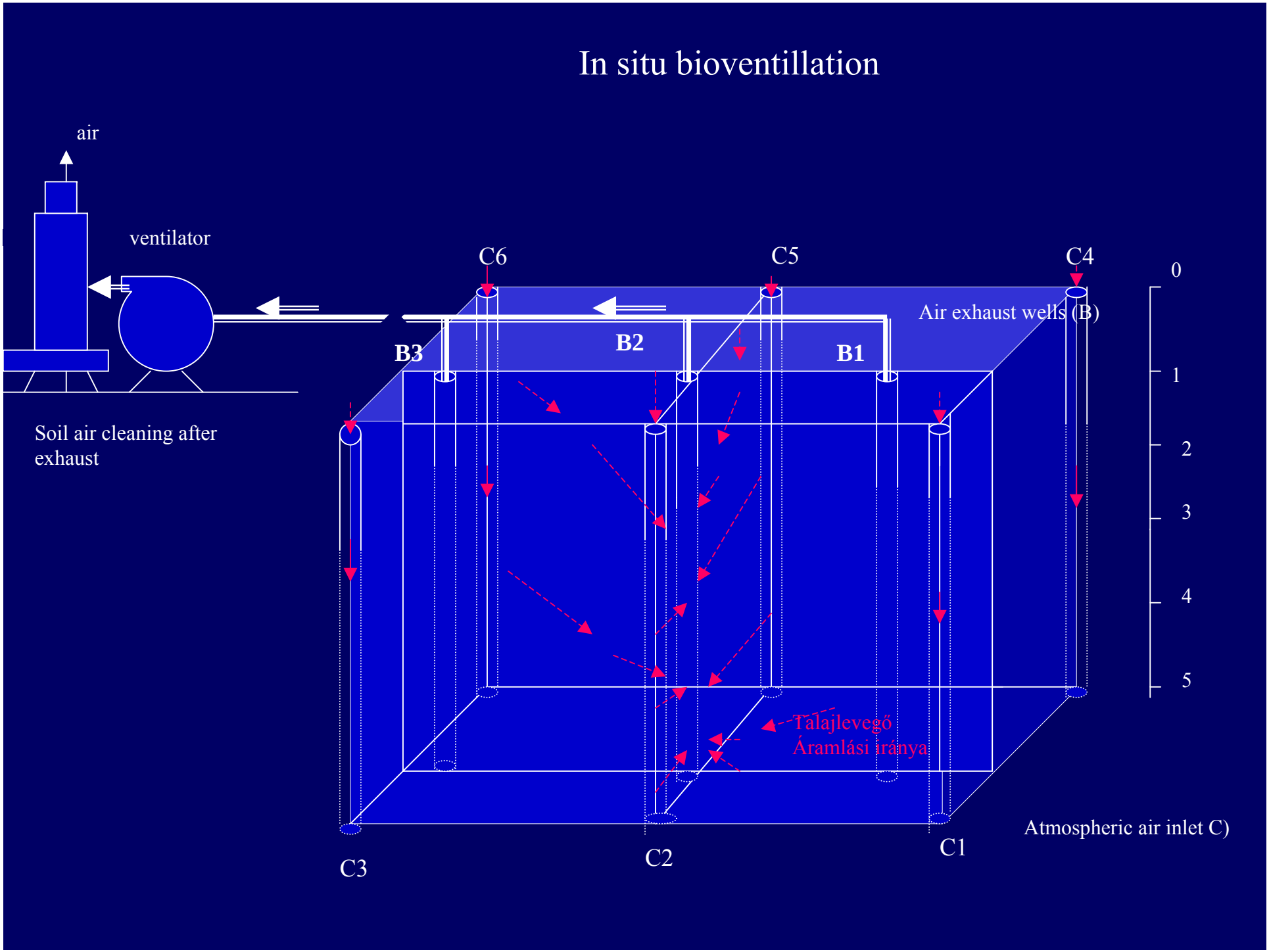
Phytovolatilisation

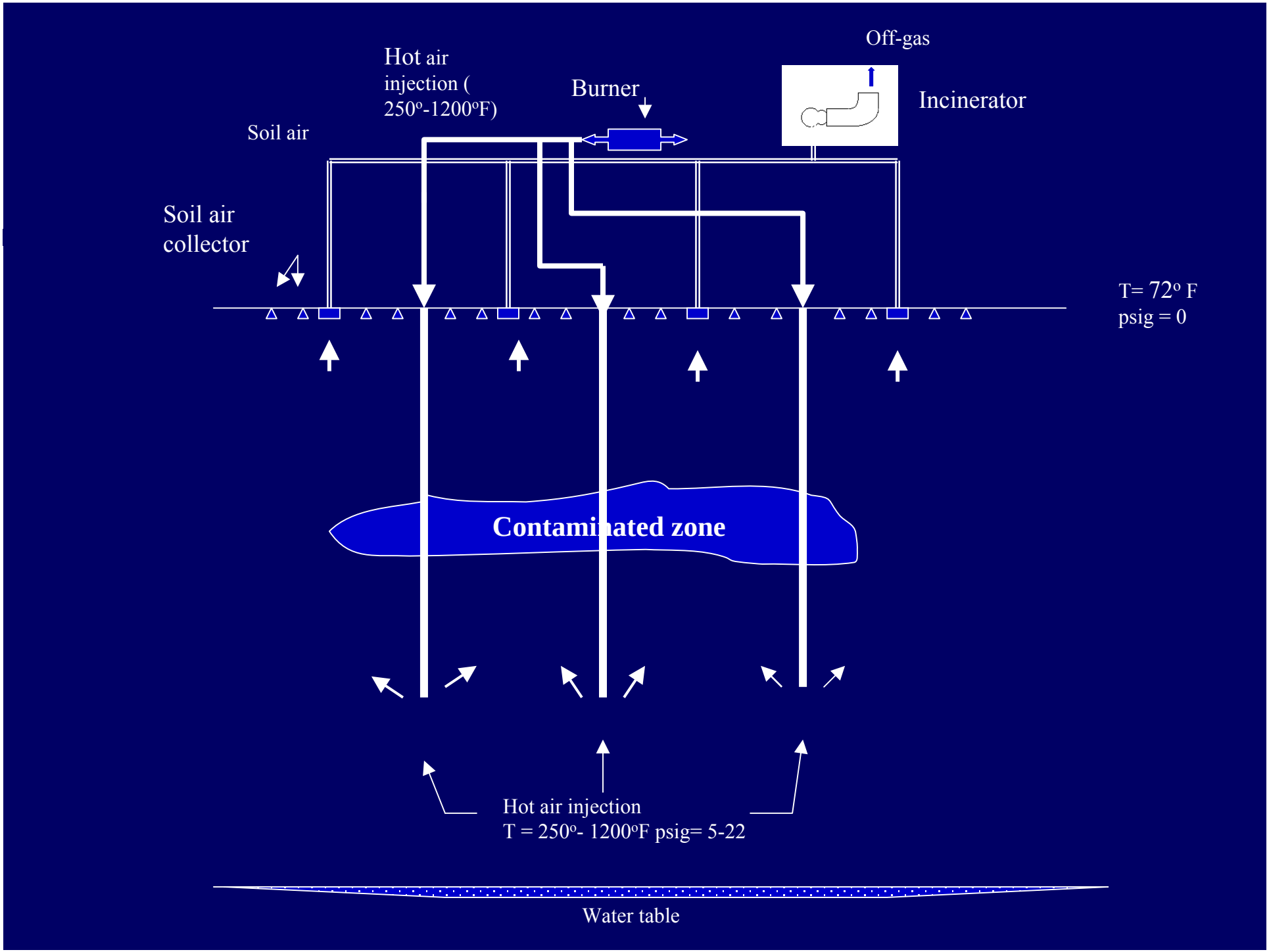
Phytodegradation

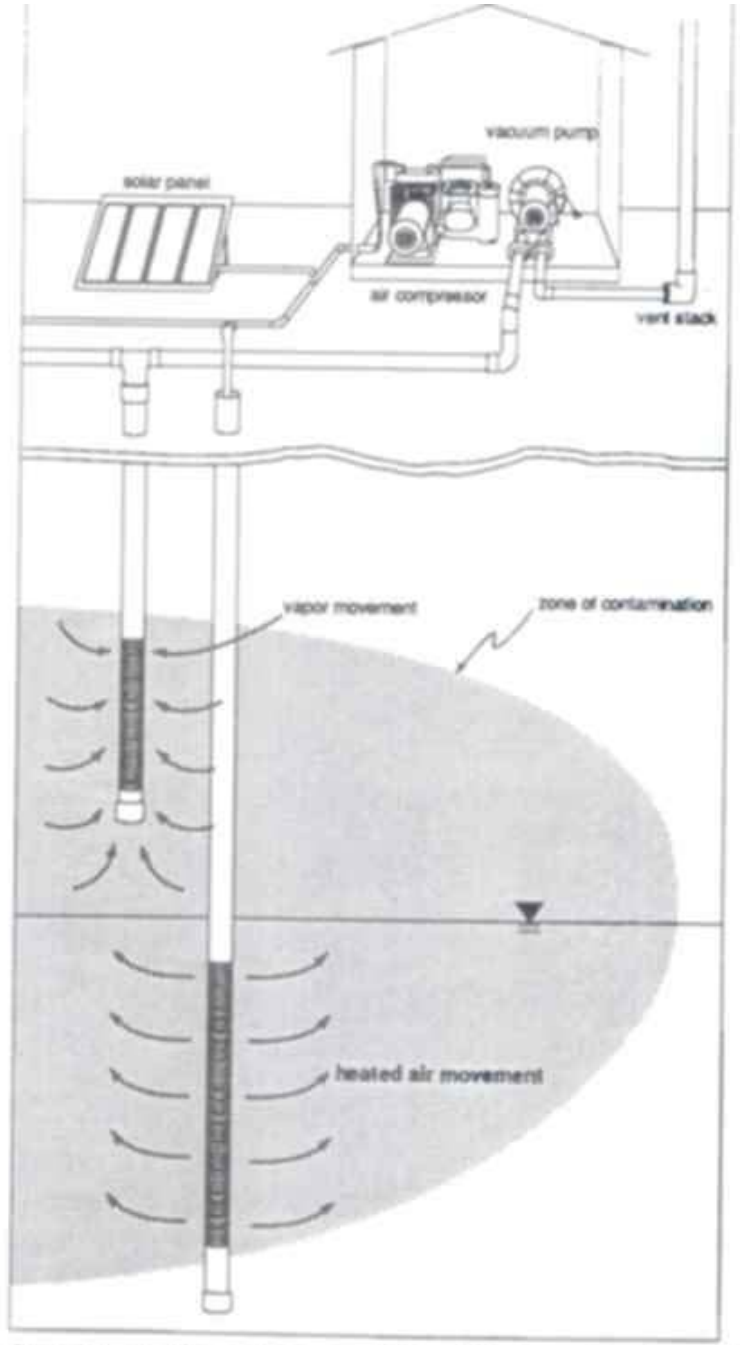
Rhyzofiltration

Living machines

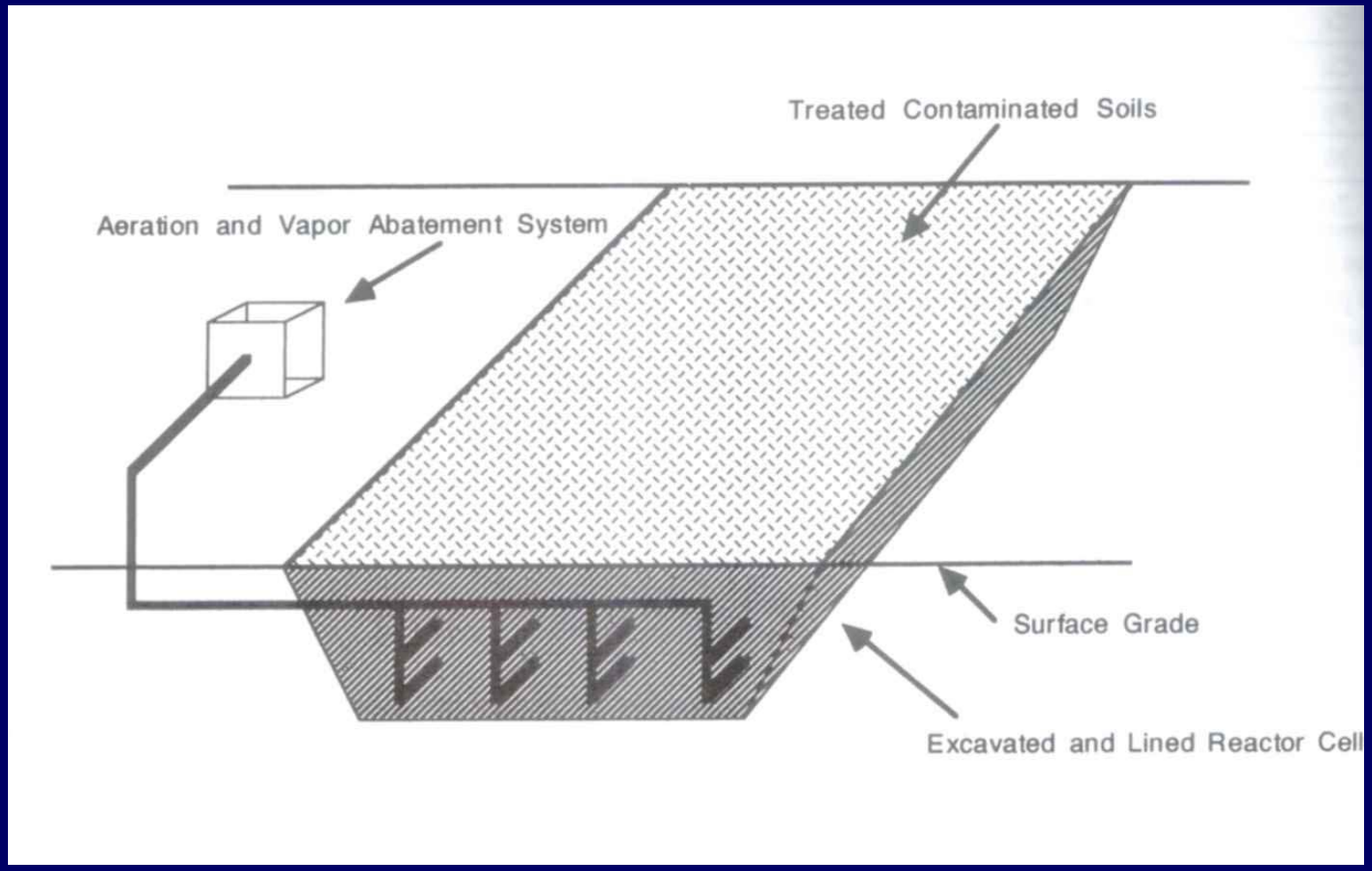
In situ bioventillation



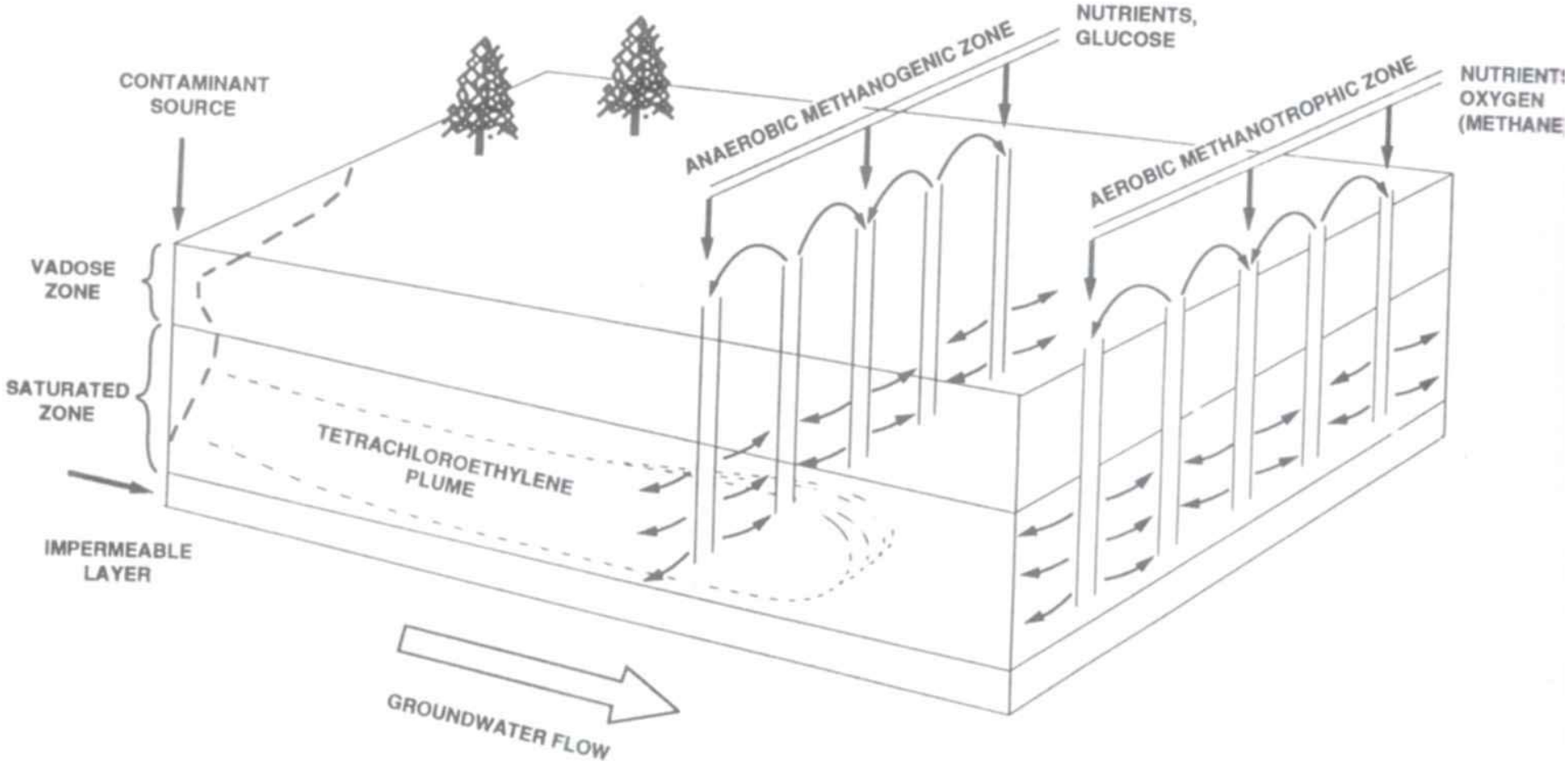

Off-gas
Hot air injection (250°-1200°F)
Burner
Incinerator
Soil air
Soil air collector
T= 72° F
psig = 0
Contaminated zone
Hot air injection
T = 250°- 1200°F psig= 5-22
Water table



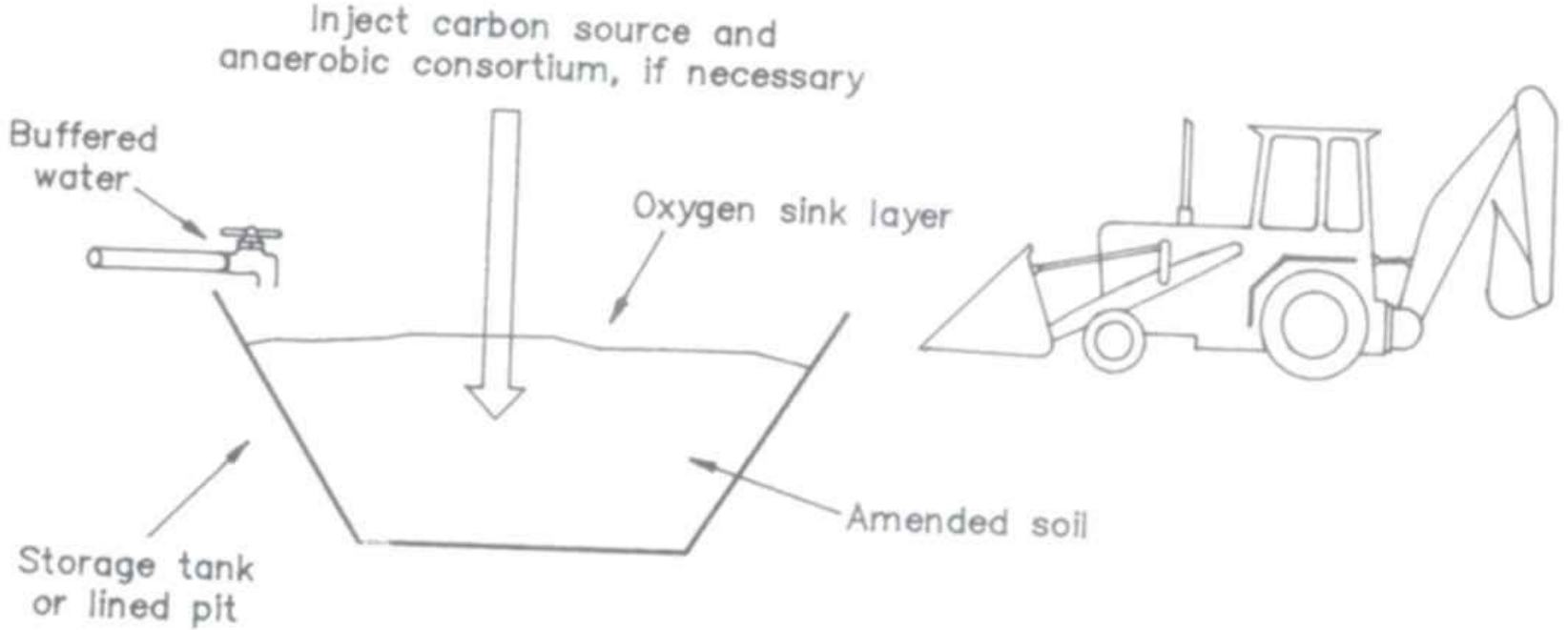
Subsurface Volatilization and Ventilation System (SVVS)



Solid phase biological treatment in reactor

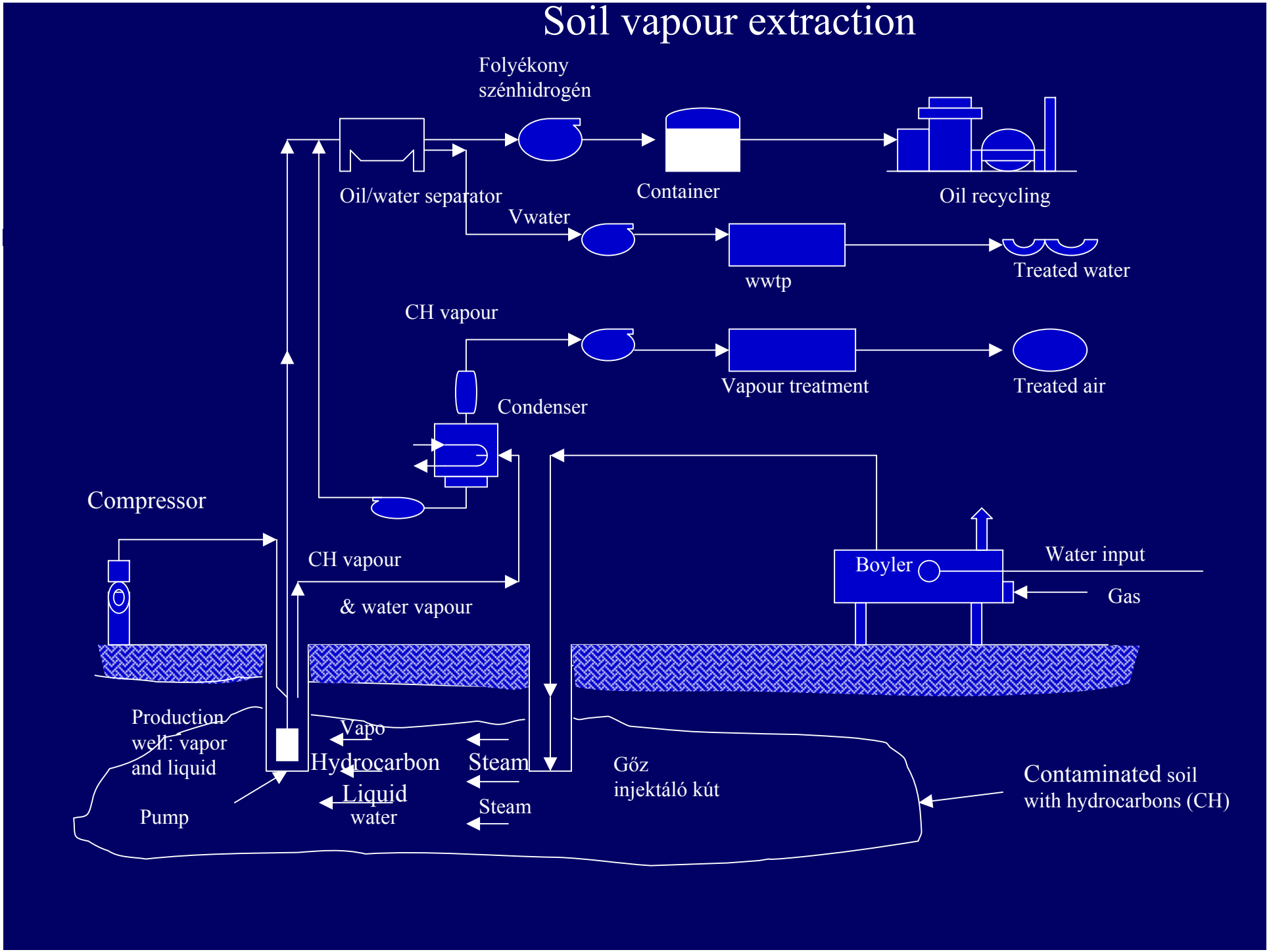


Two-zones biological tretament : 1. Anaerobic, 2. aerobic

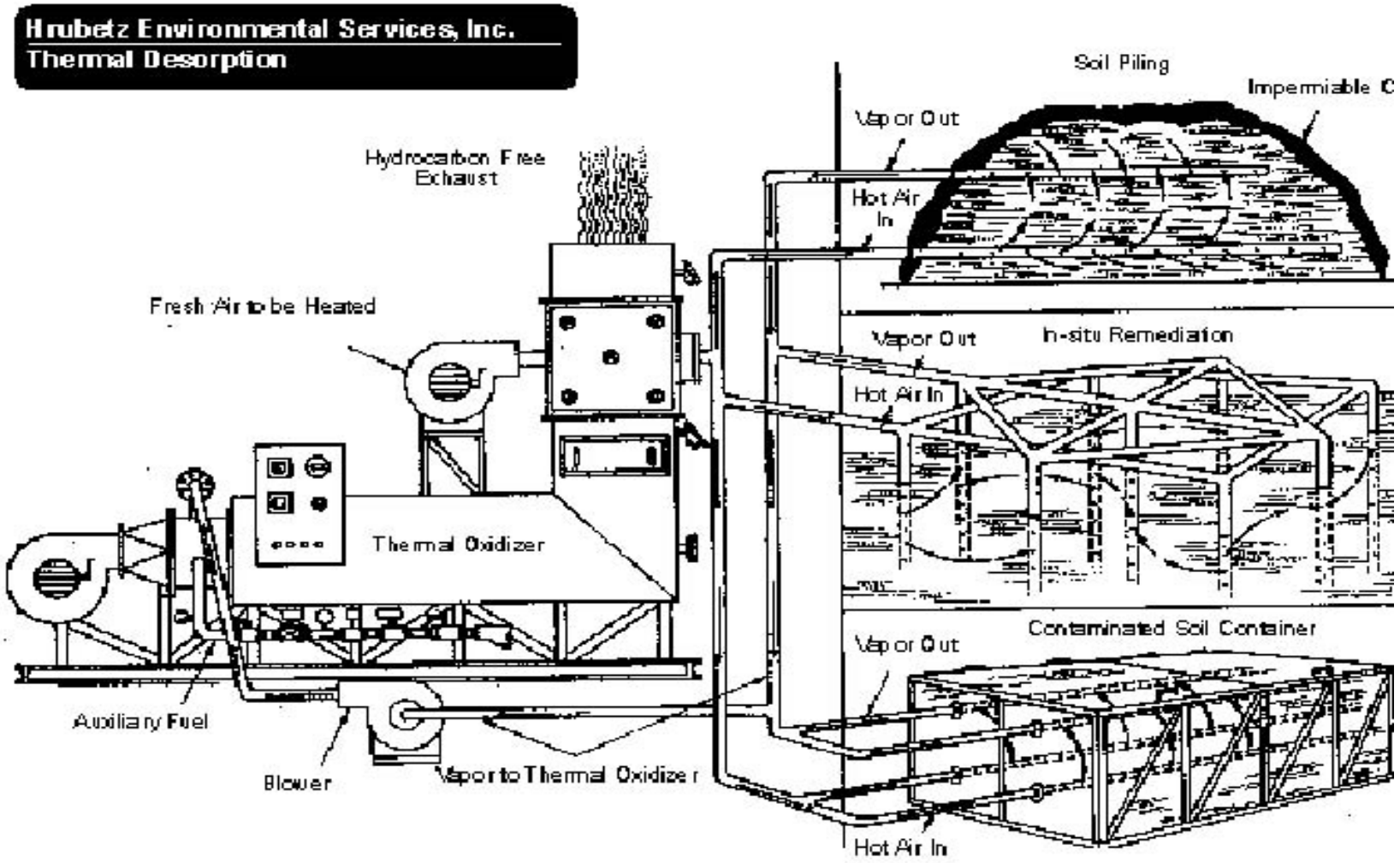


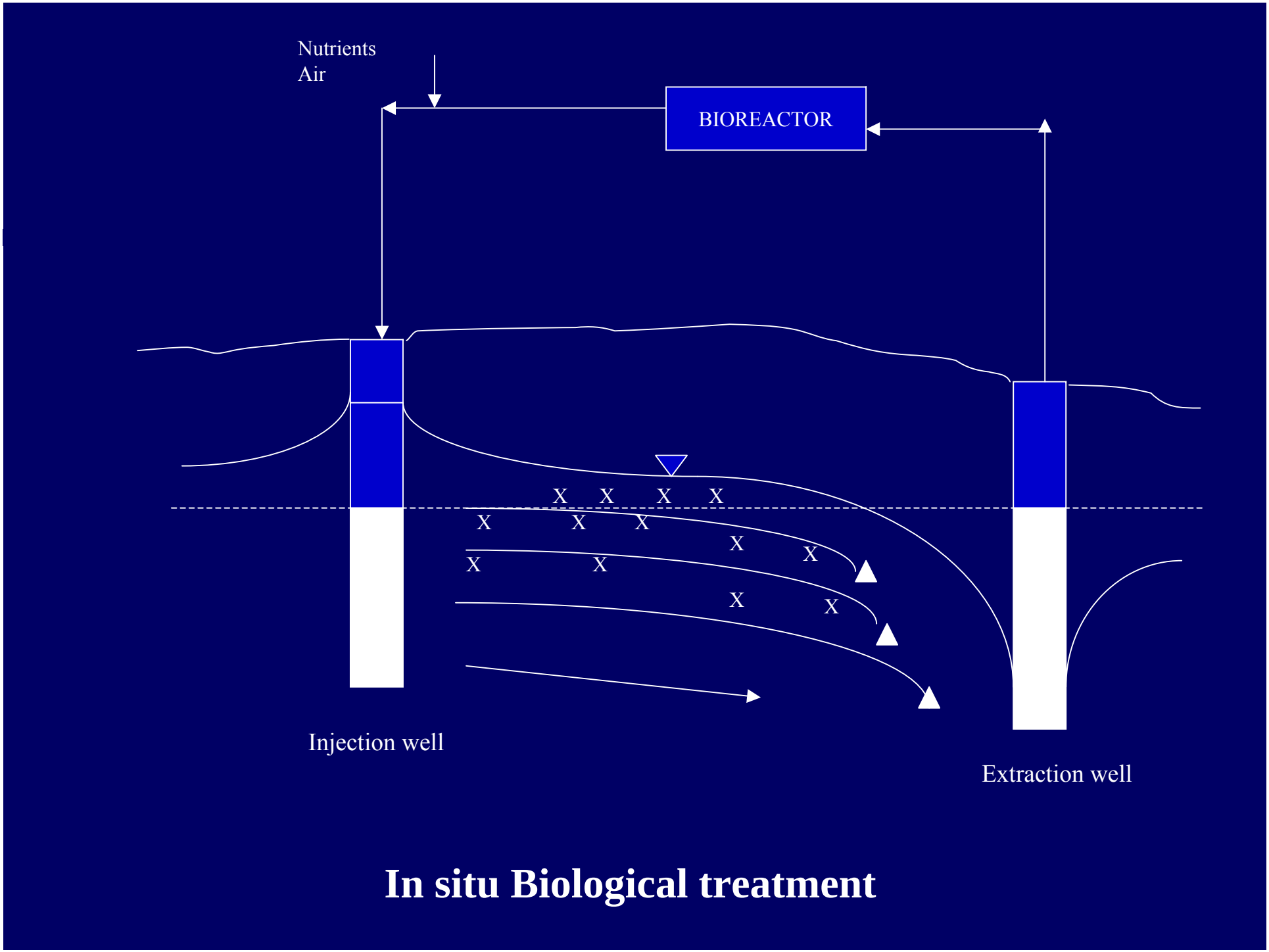
Anaerob biological soil treatment in slurry phase

Soil vapour extraction



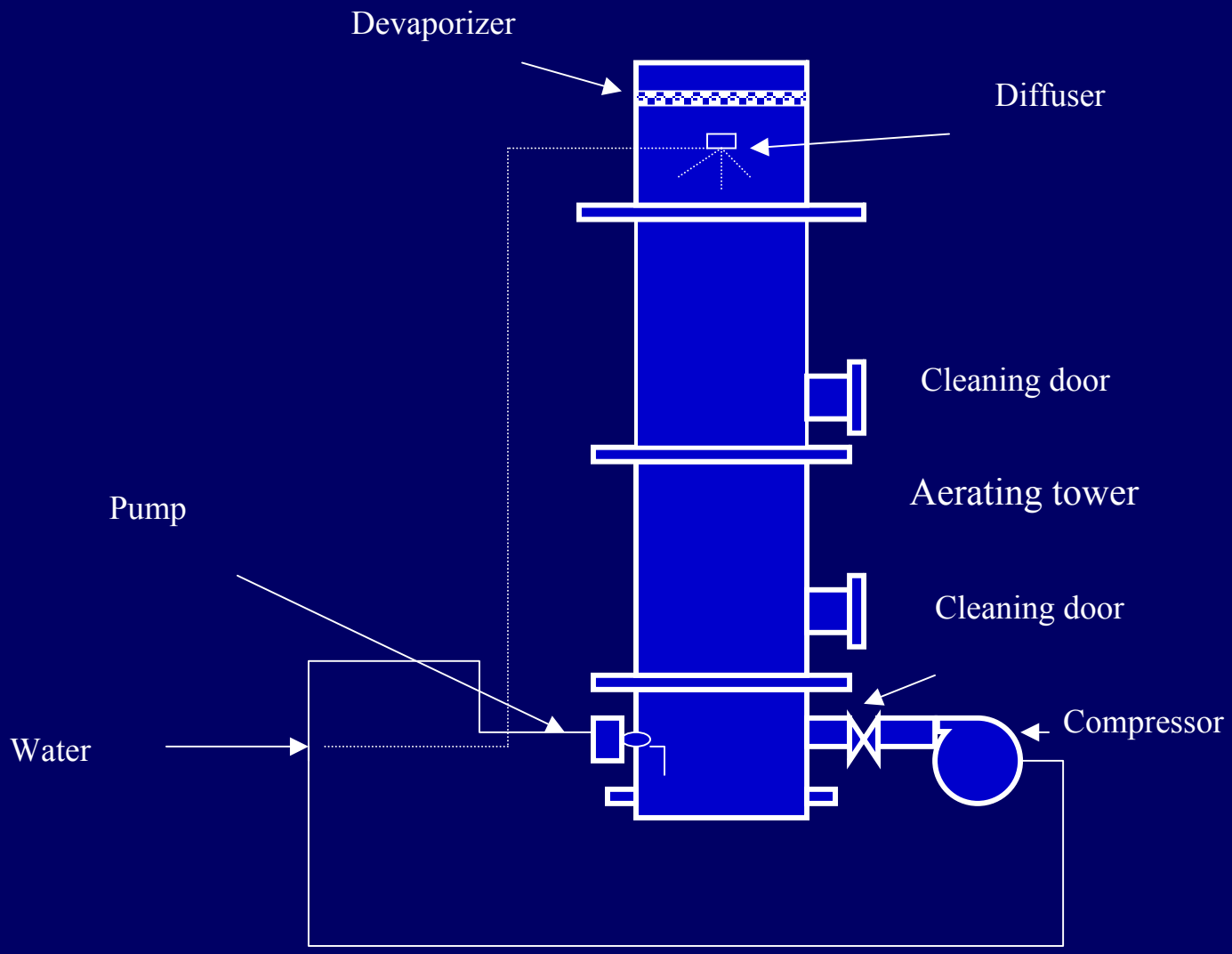
Thermal desorption

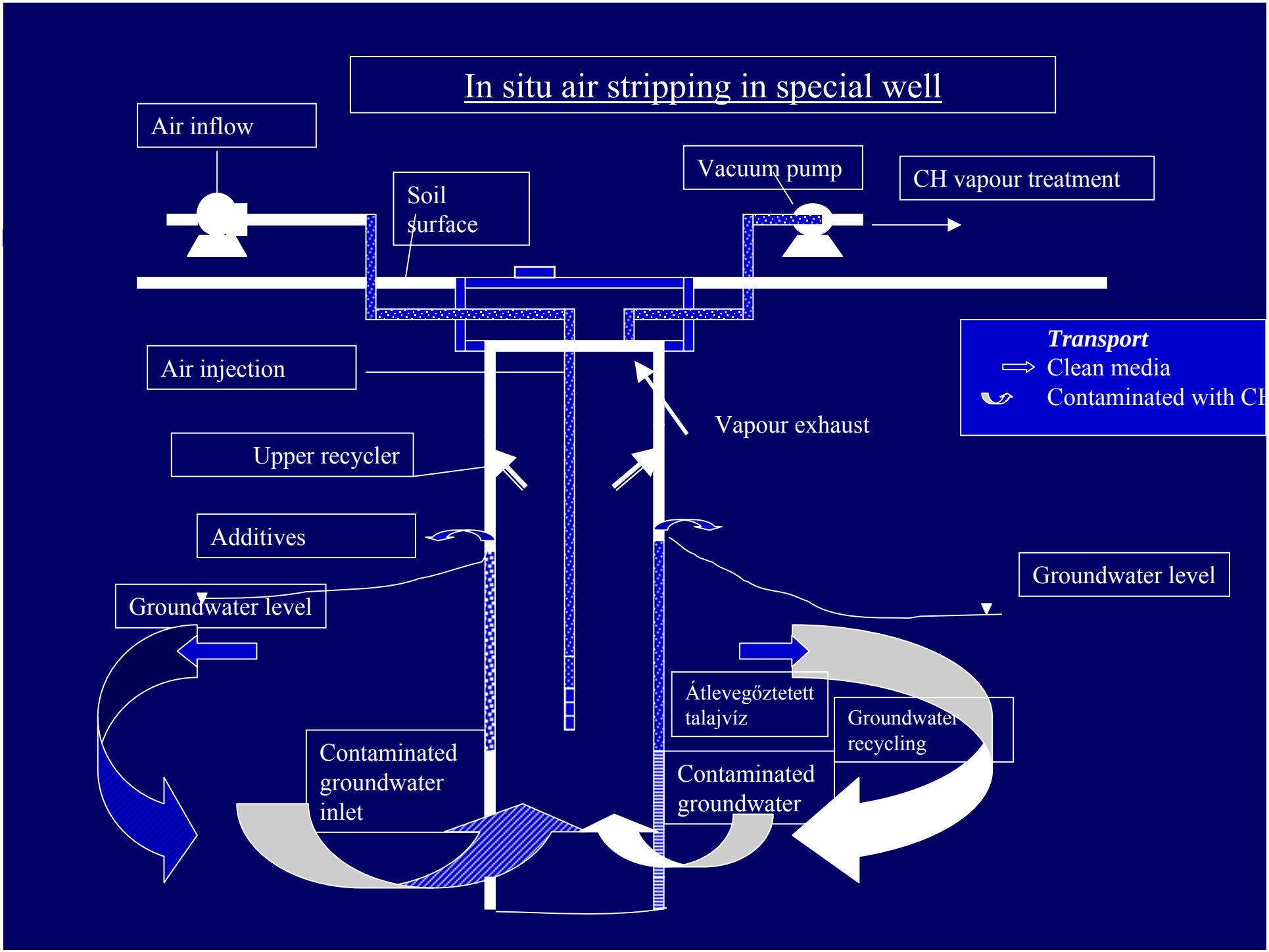




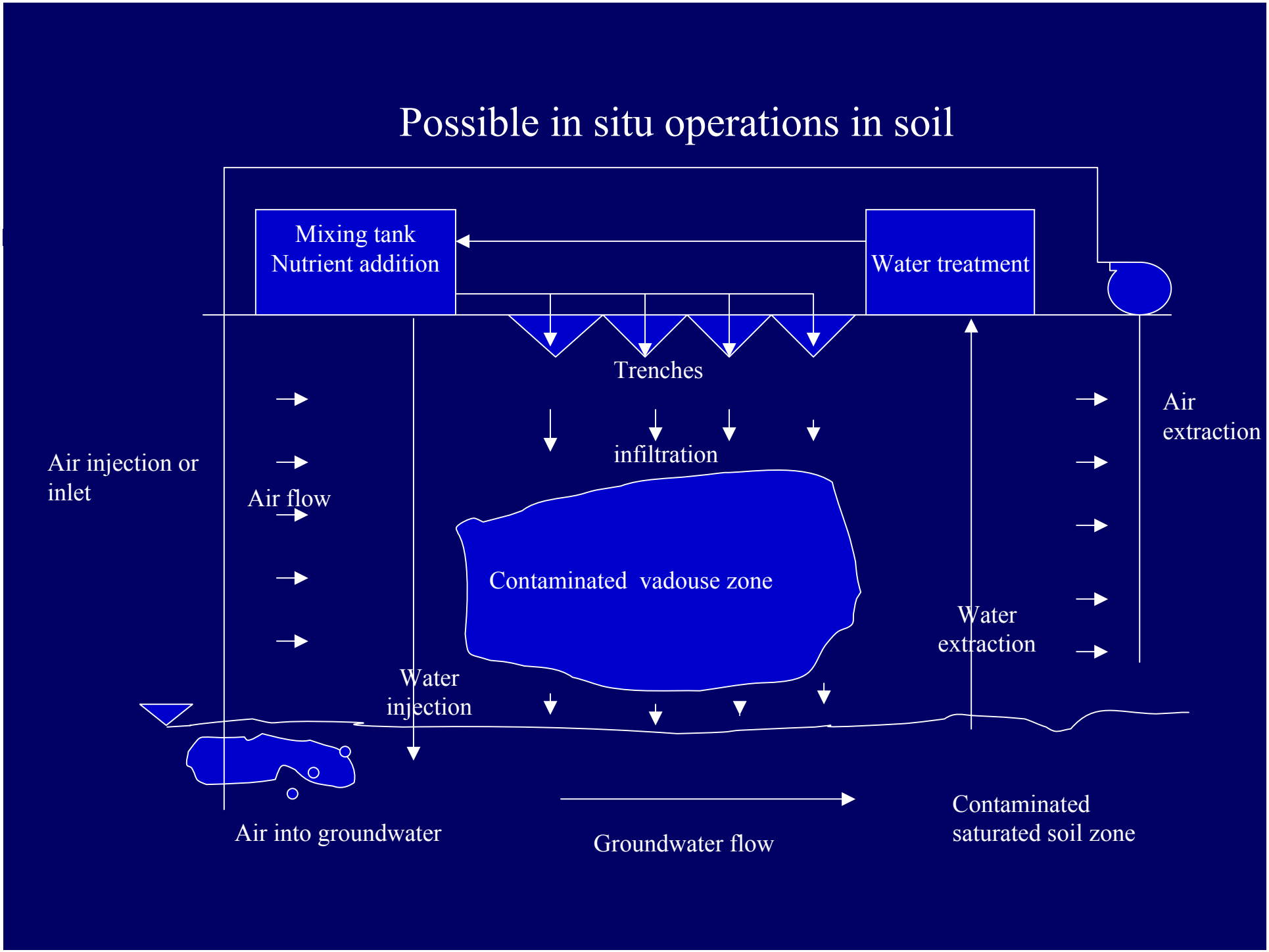
In situ Biological treatment

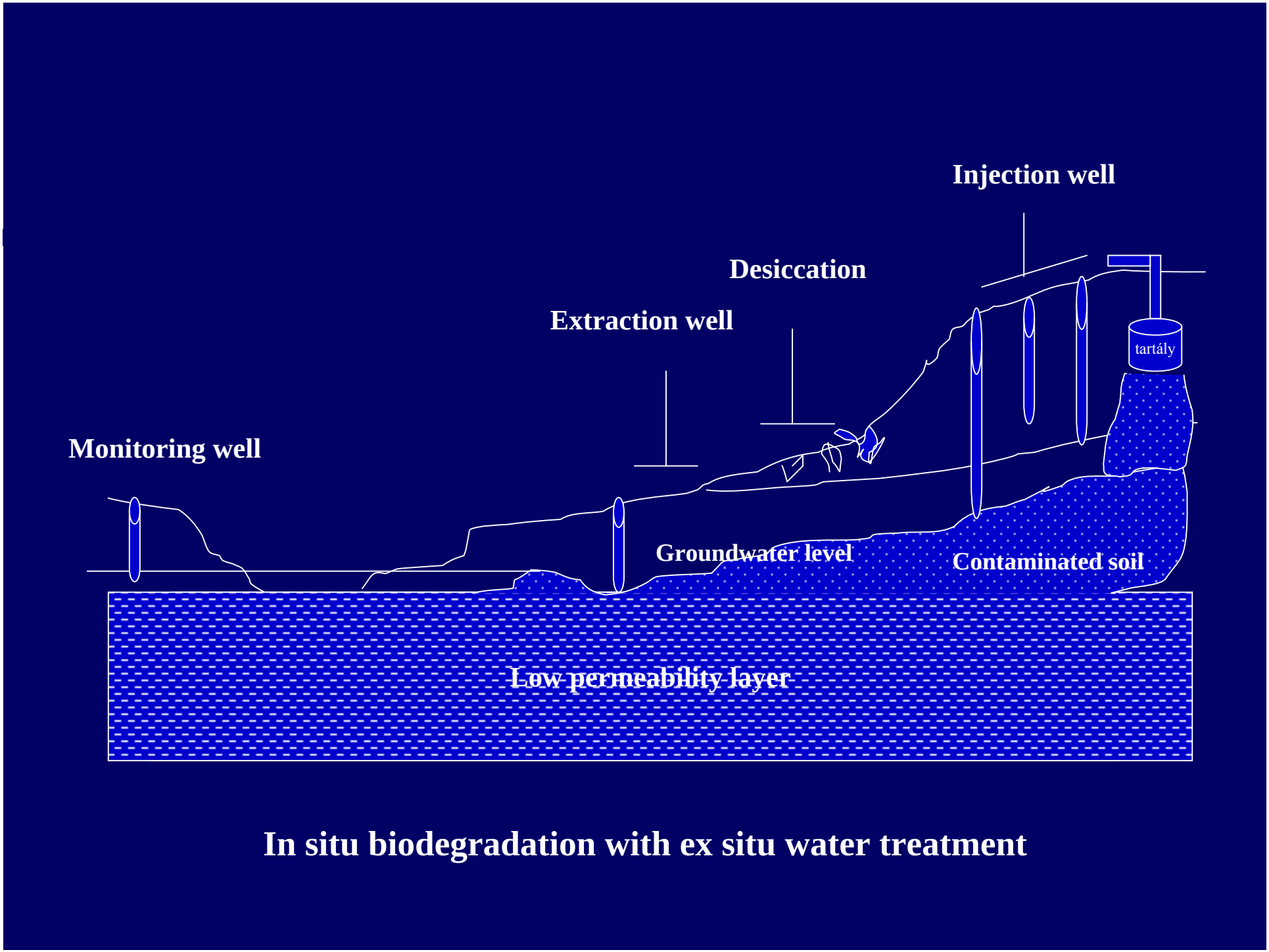
AIR STRIPPING




In situ air stripping in special well
Air inflow
Soil surface
Vacuum pump
CH vapour treatment
Air injection
Vapour exhaust
Transport
Clean media
Contaminated with CH
Upper recycler
Additives
Groundwater level
Groundwater level
Átlevegőztetett talajvíz
Groundwater recycling
Contaminated groundwater inlet
Contaminated groundwater

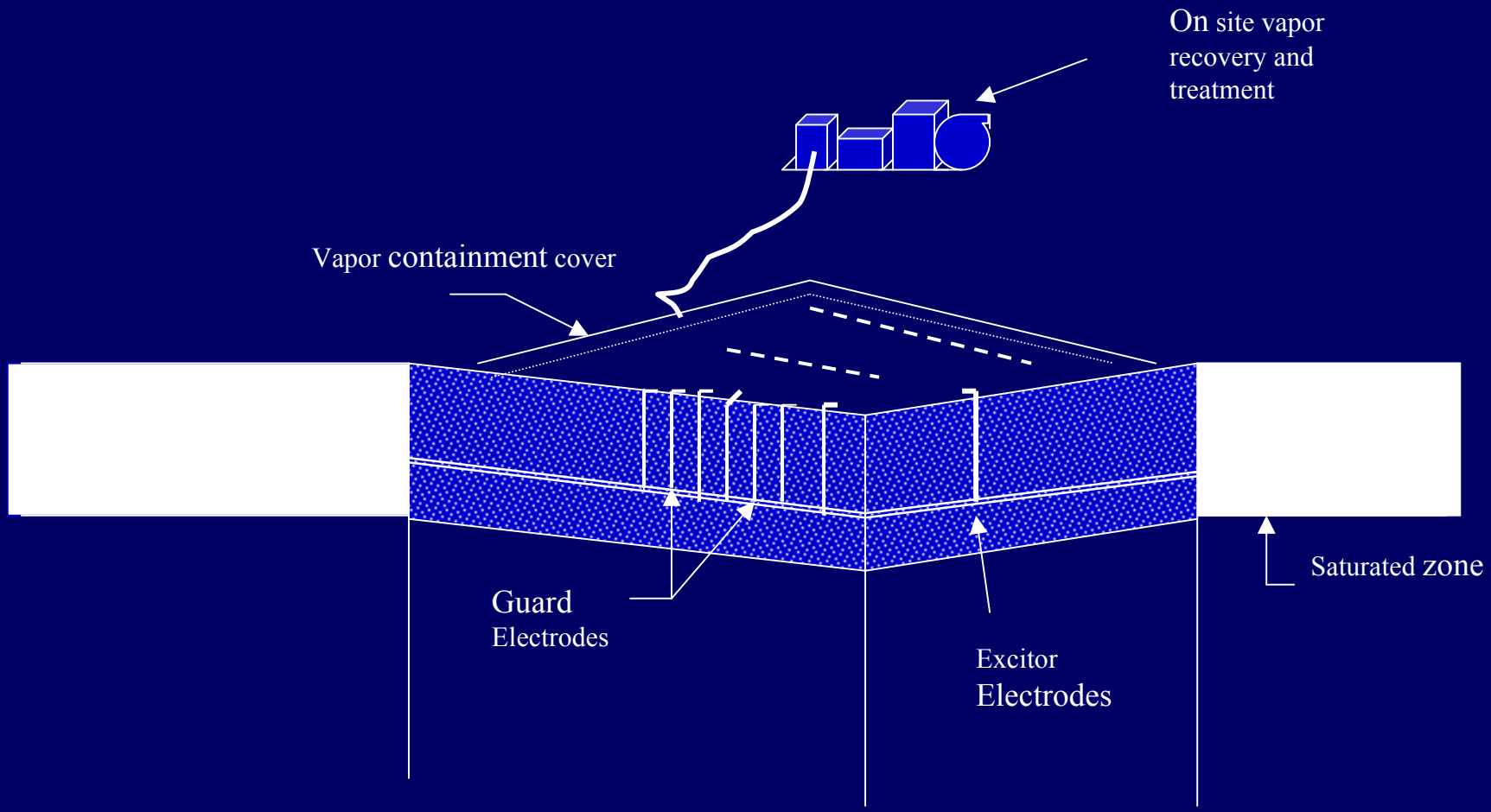
Possible in situ operations in soil

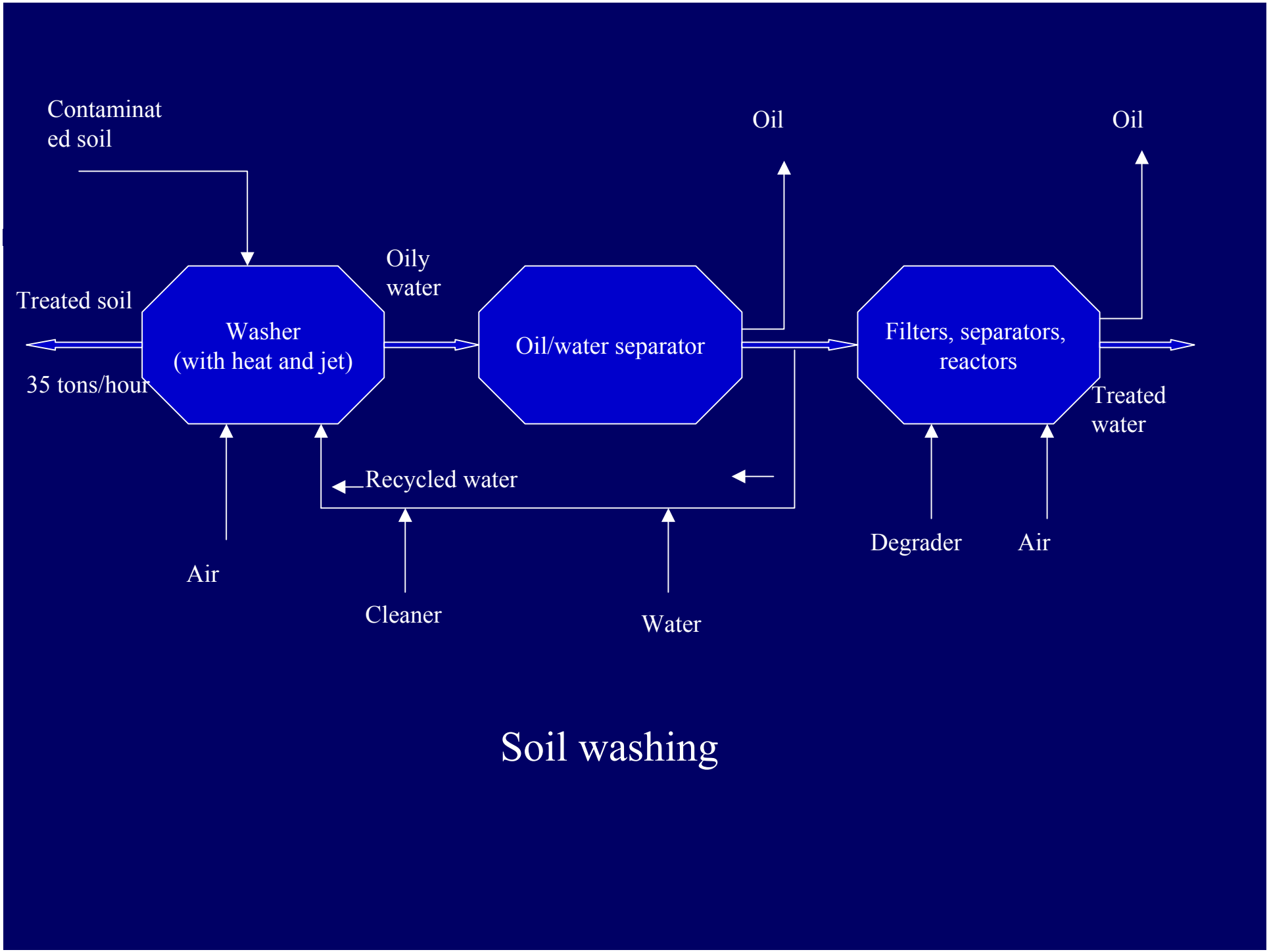




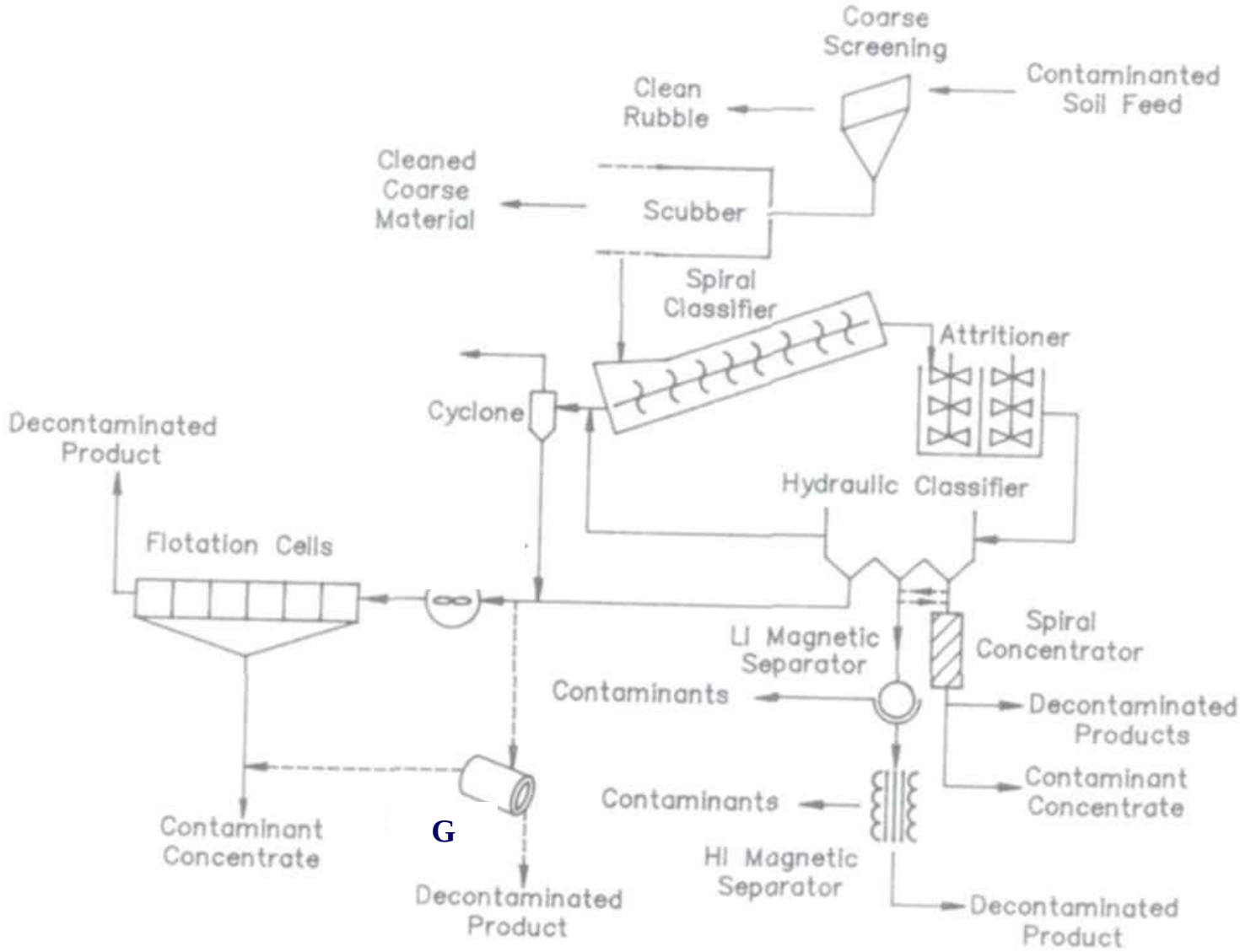
In situ biodegradation with ex situ water treatment

In situ soil heating with radiofrequency

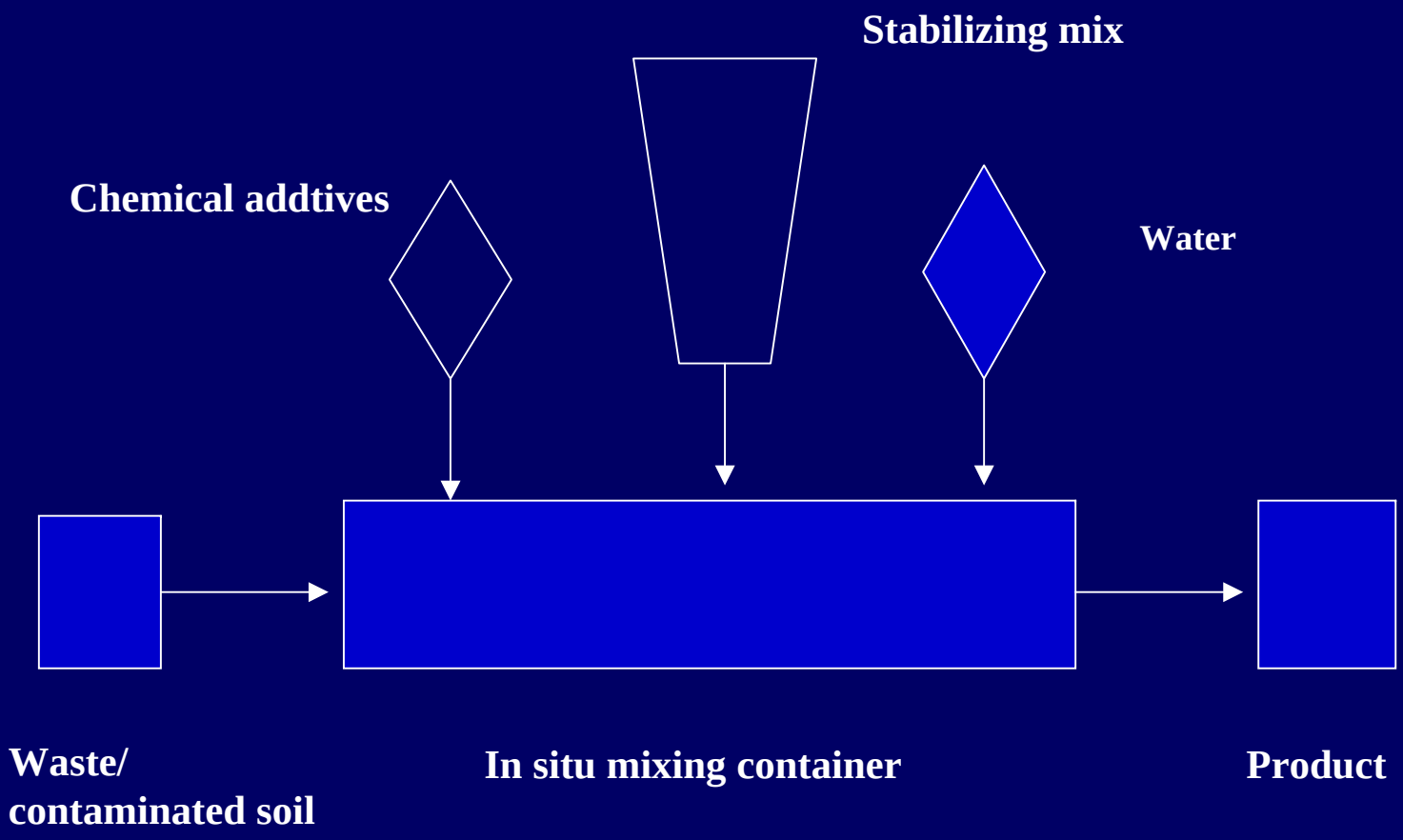




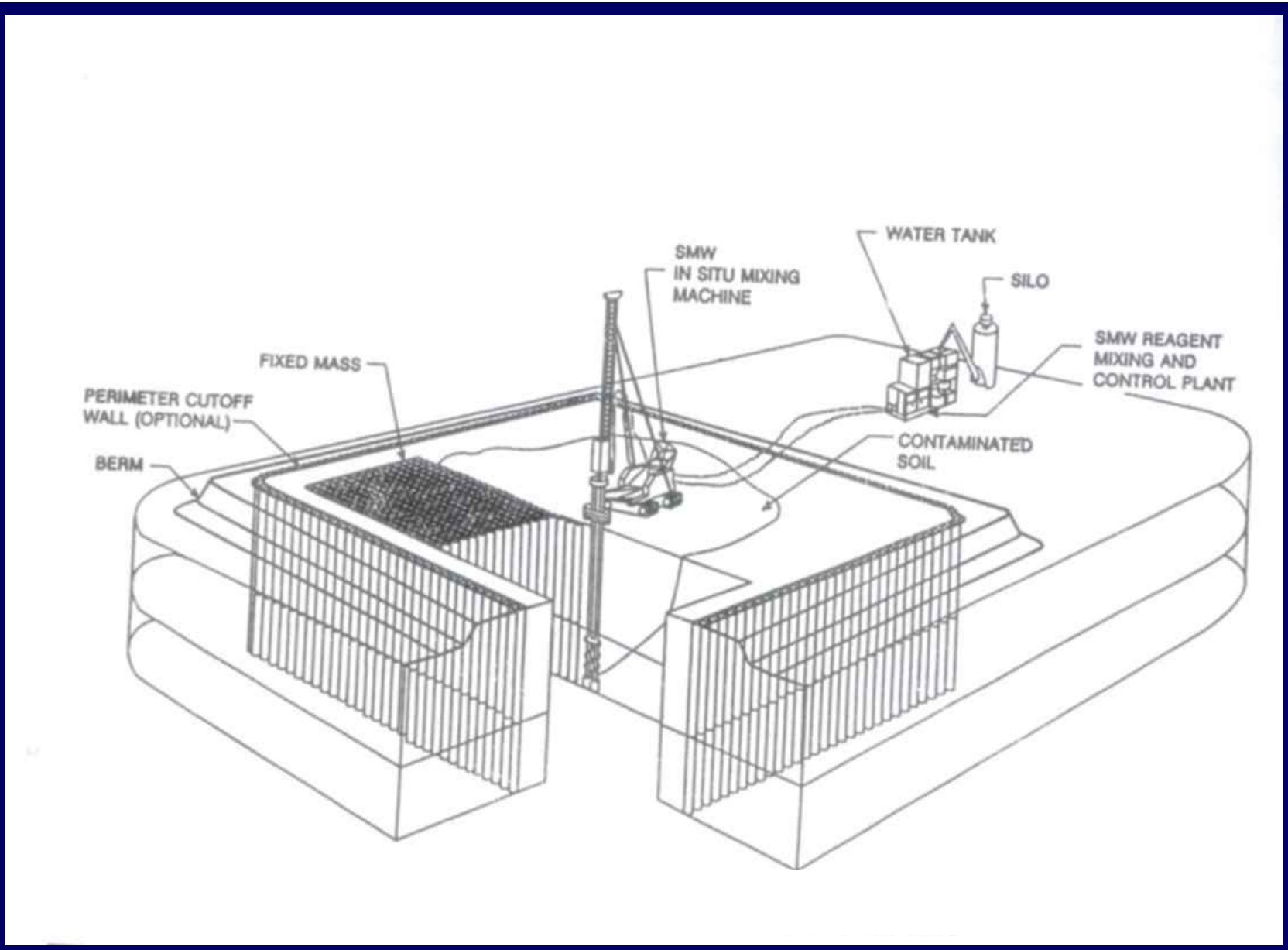
Soil washing



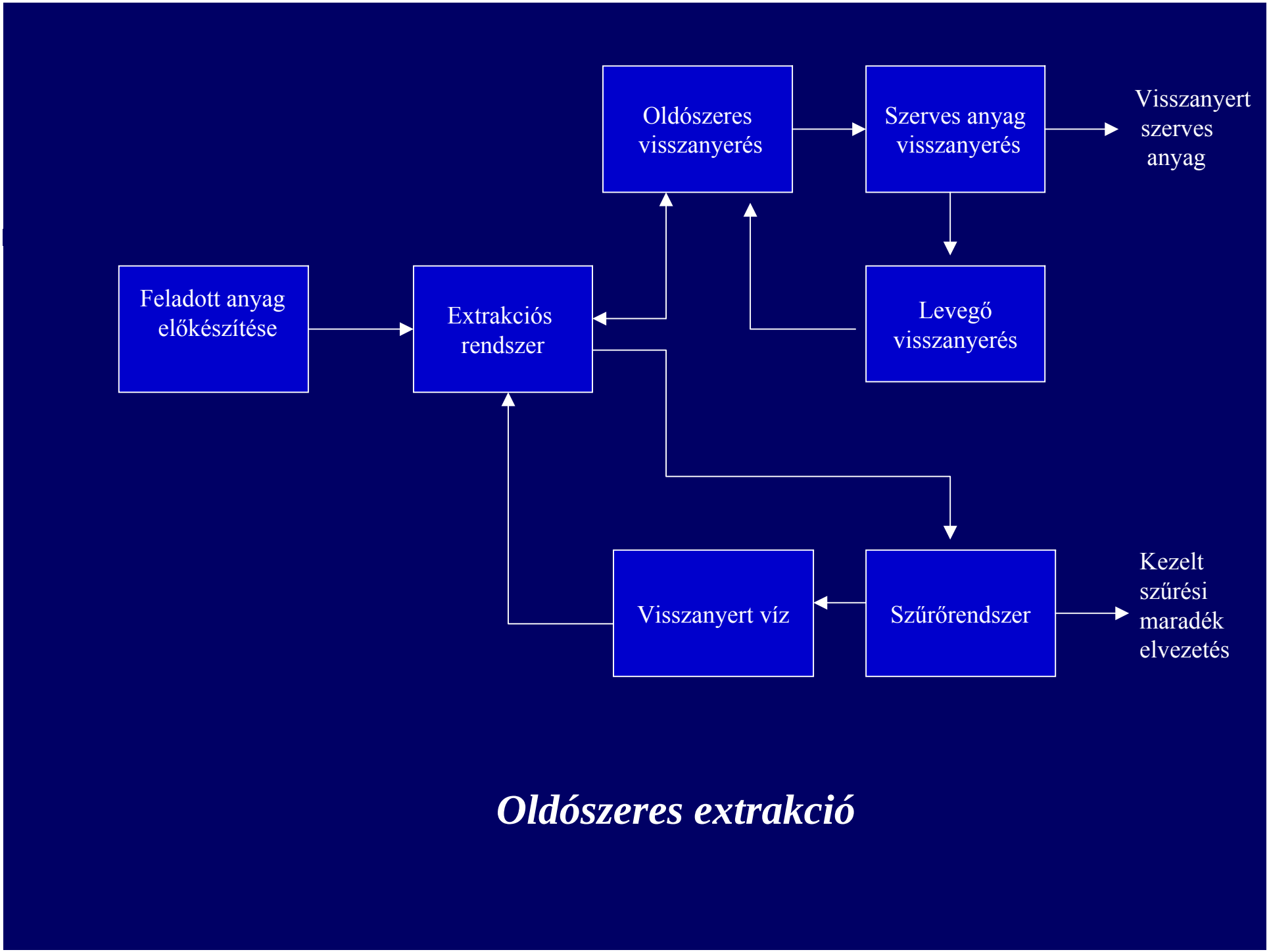
Complex physical soil treatment



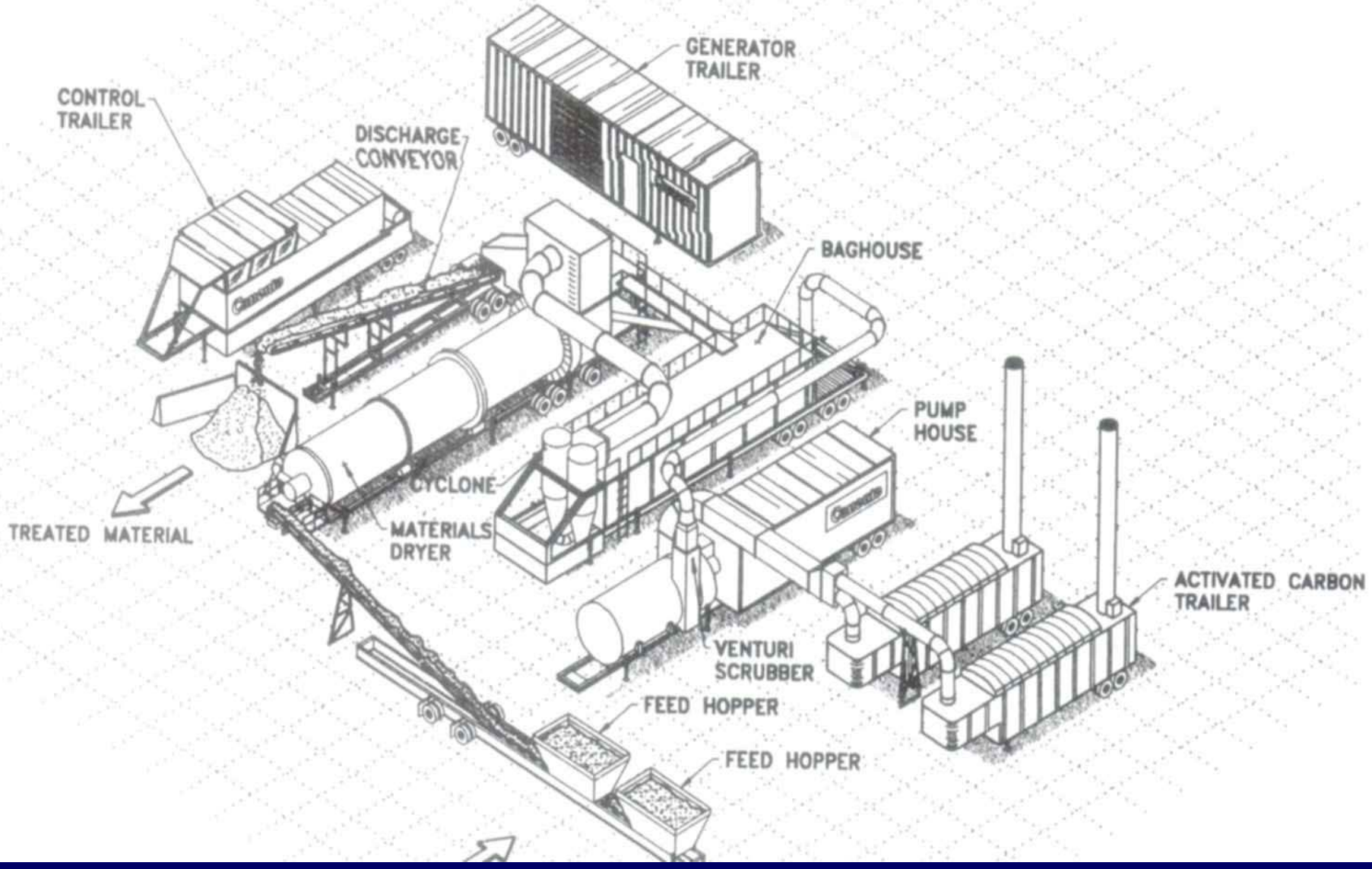
Dechlorination with stabilisation



In situ solidification

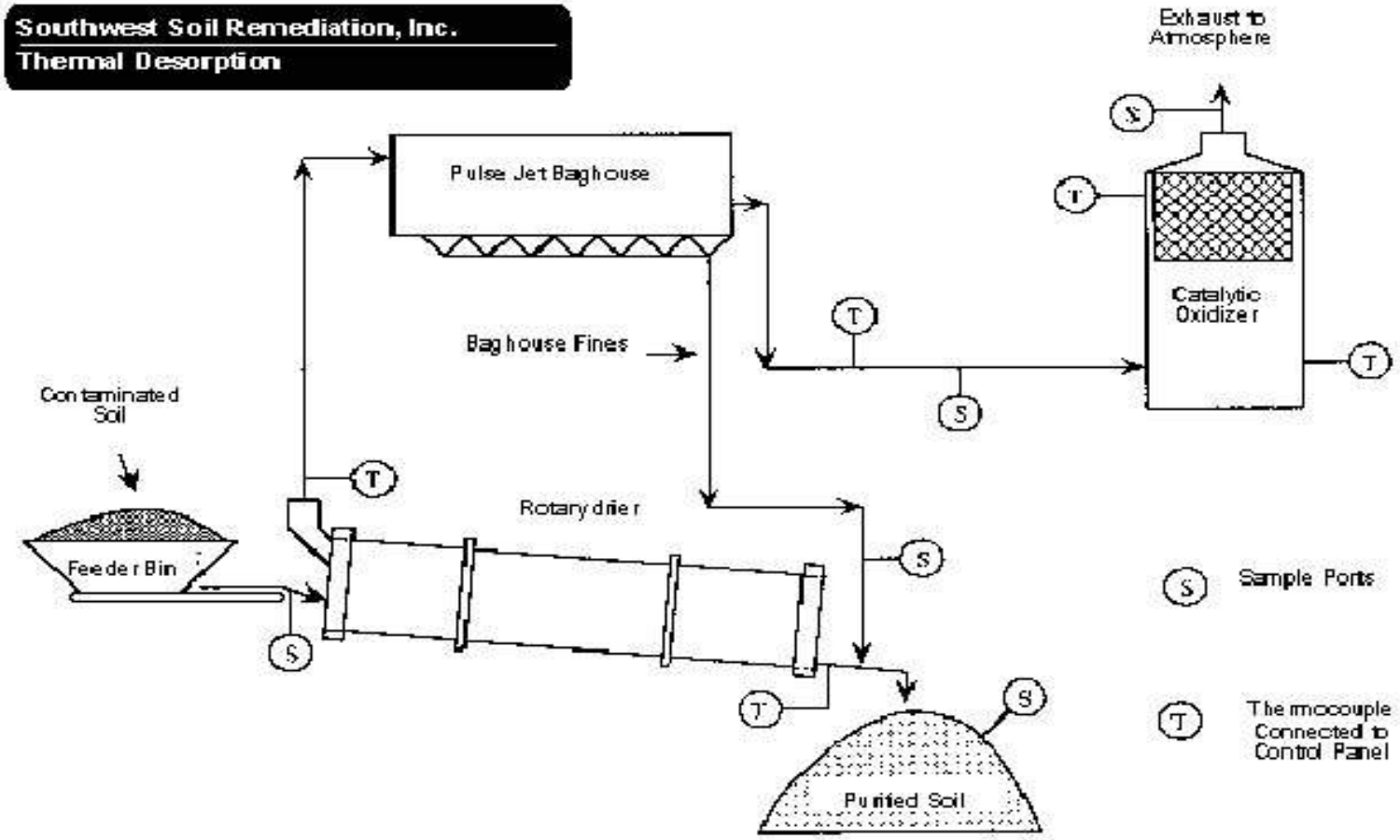


Oldószeres extrakció

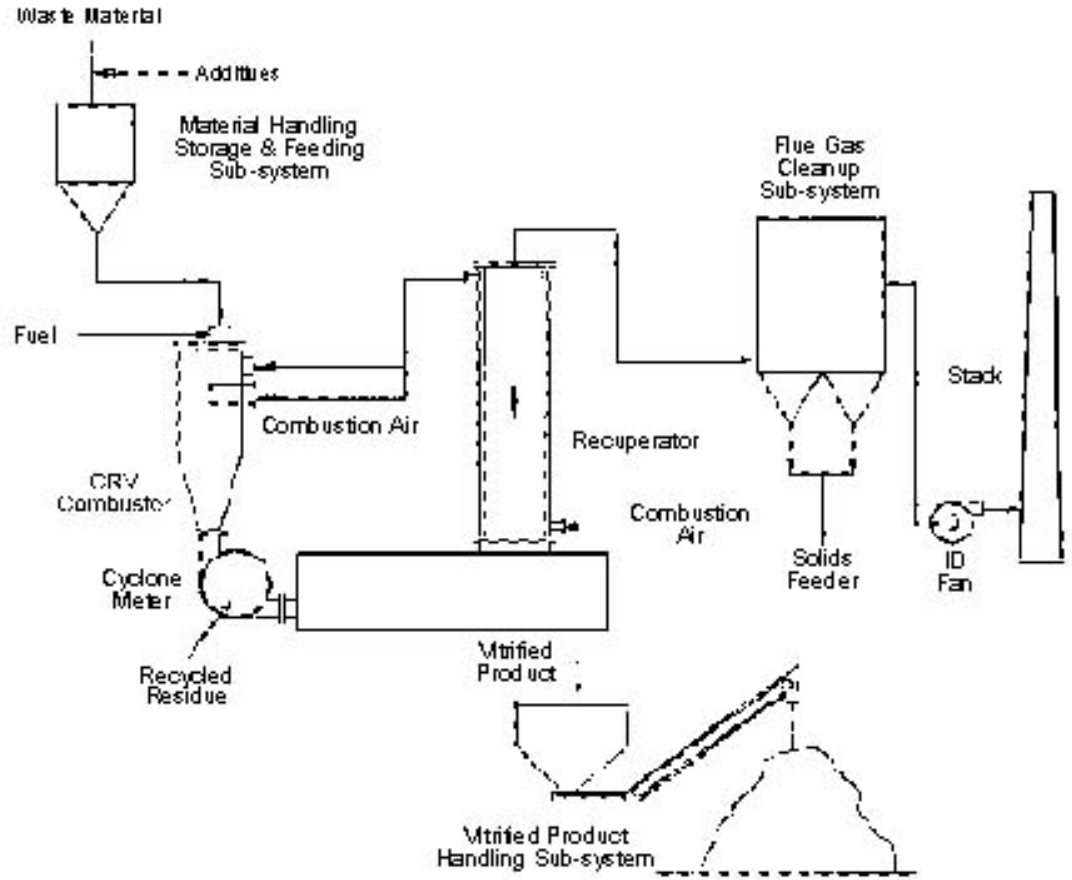


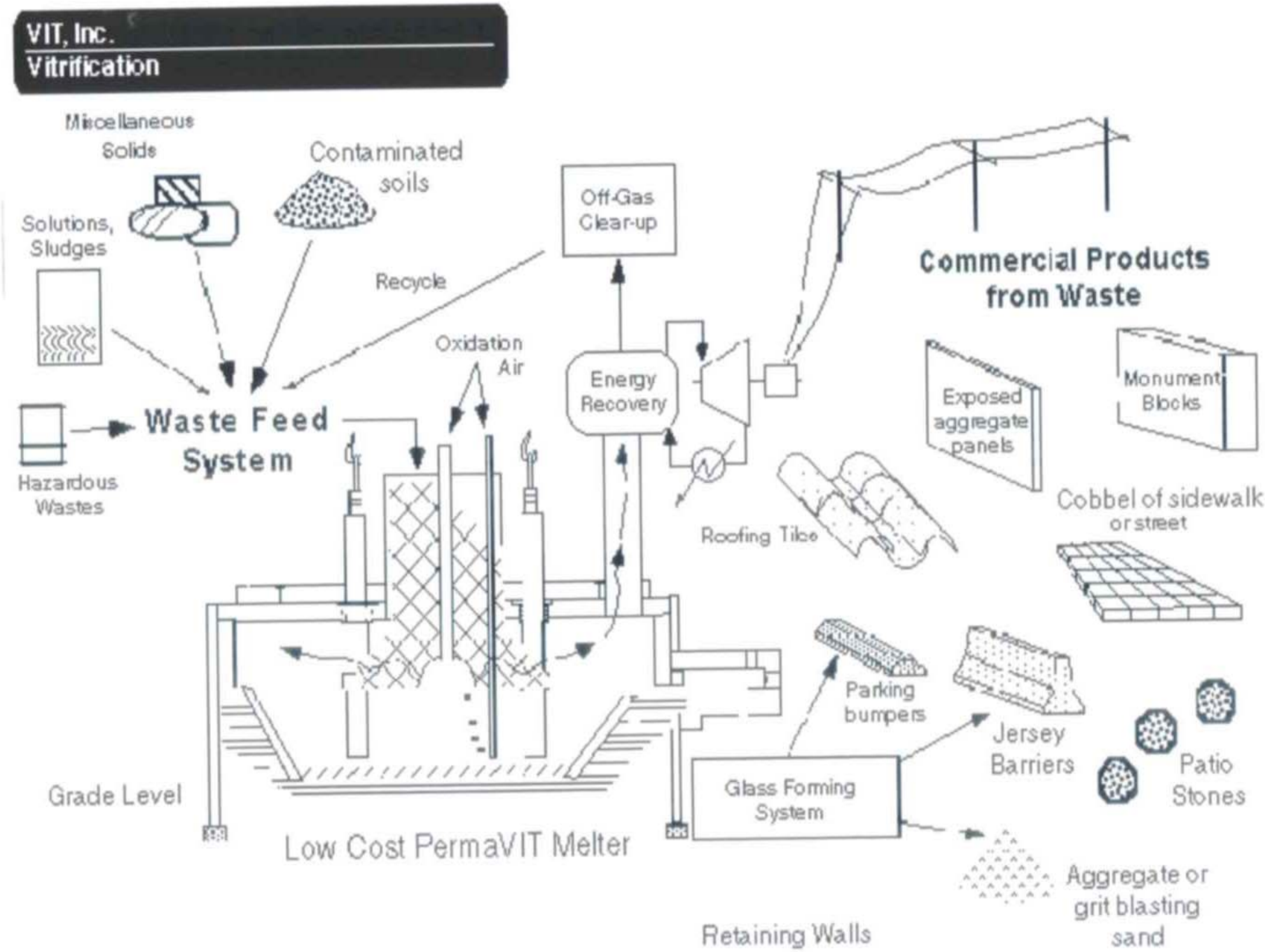
Thermal desorption

Southwest Soil Remediation, Inc.
Thermal Desorption



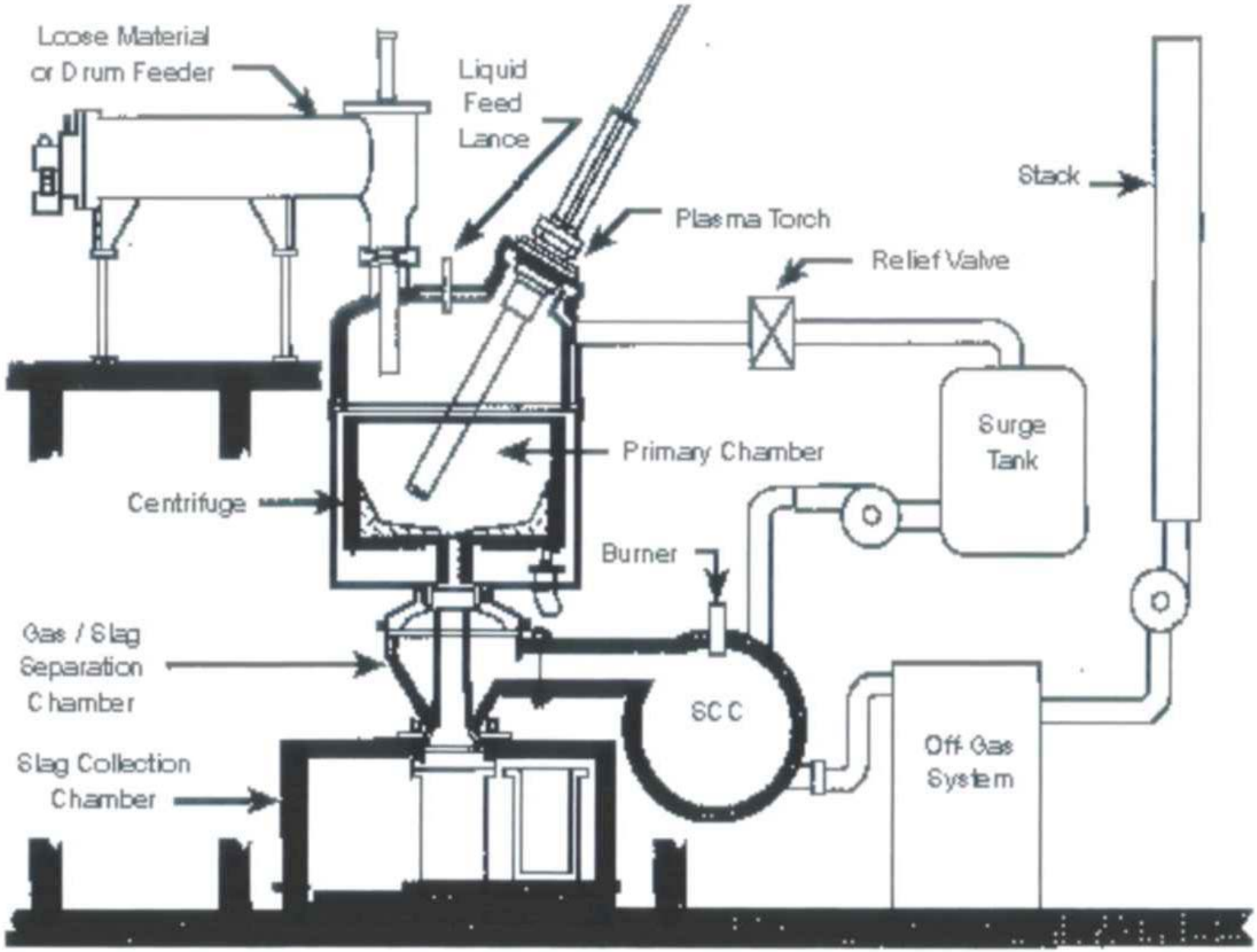
Vortec Corporation
Vitrification

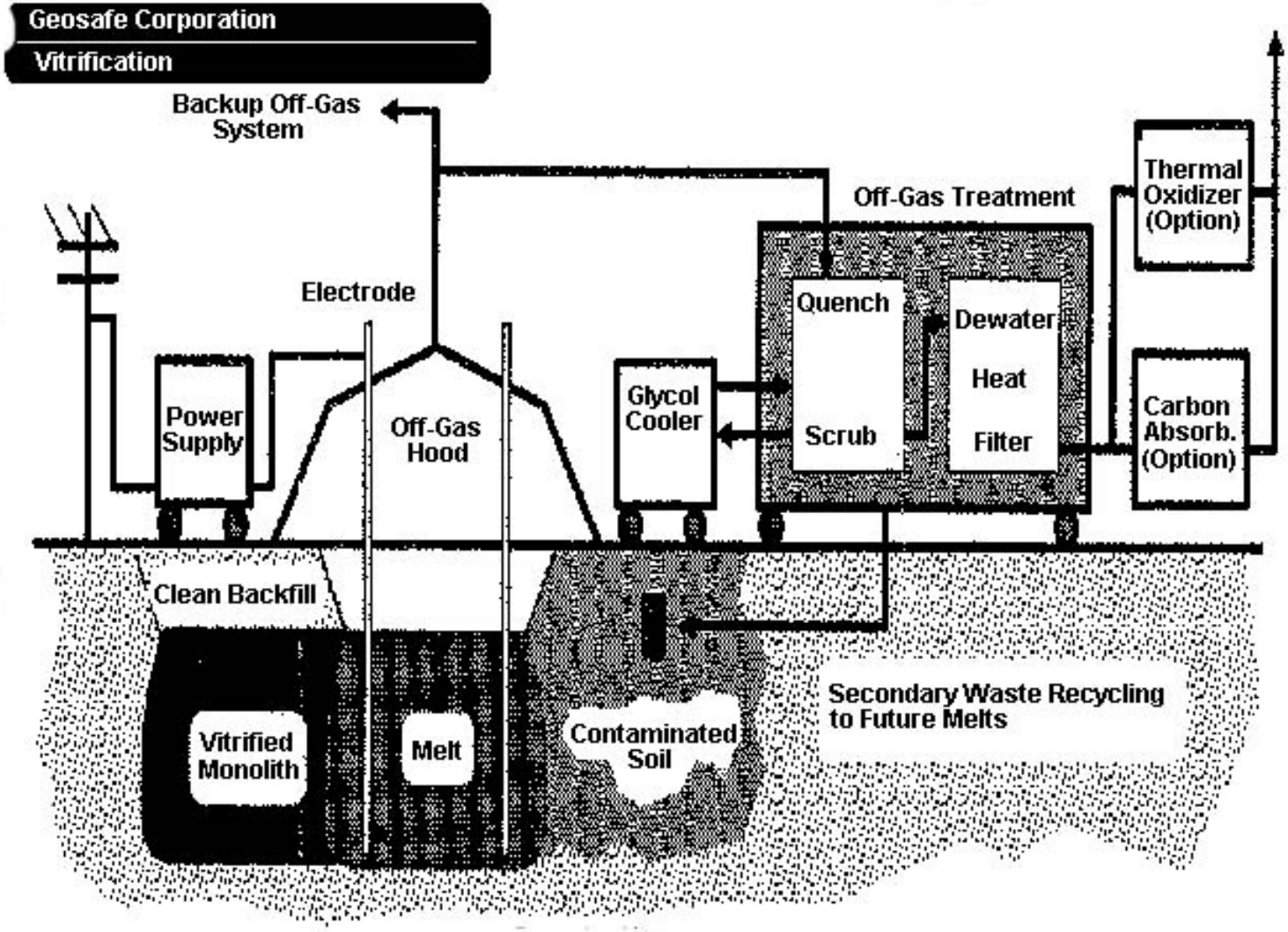


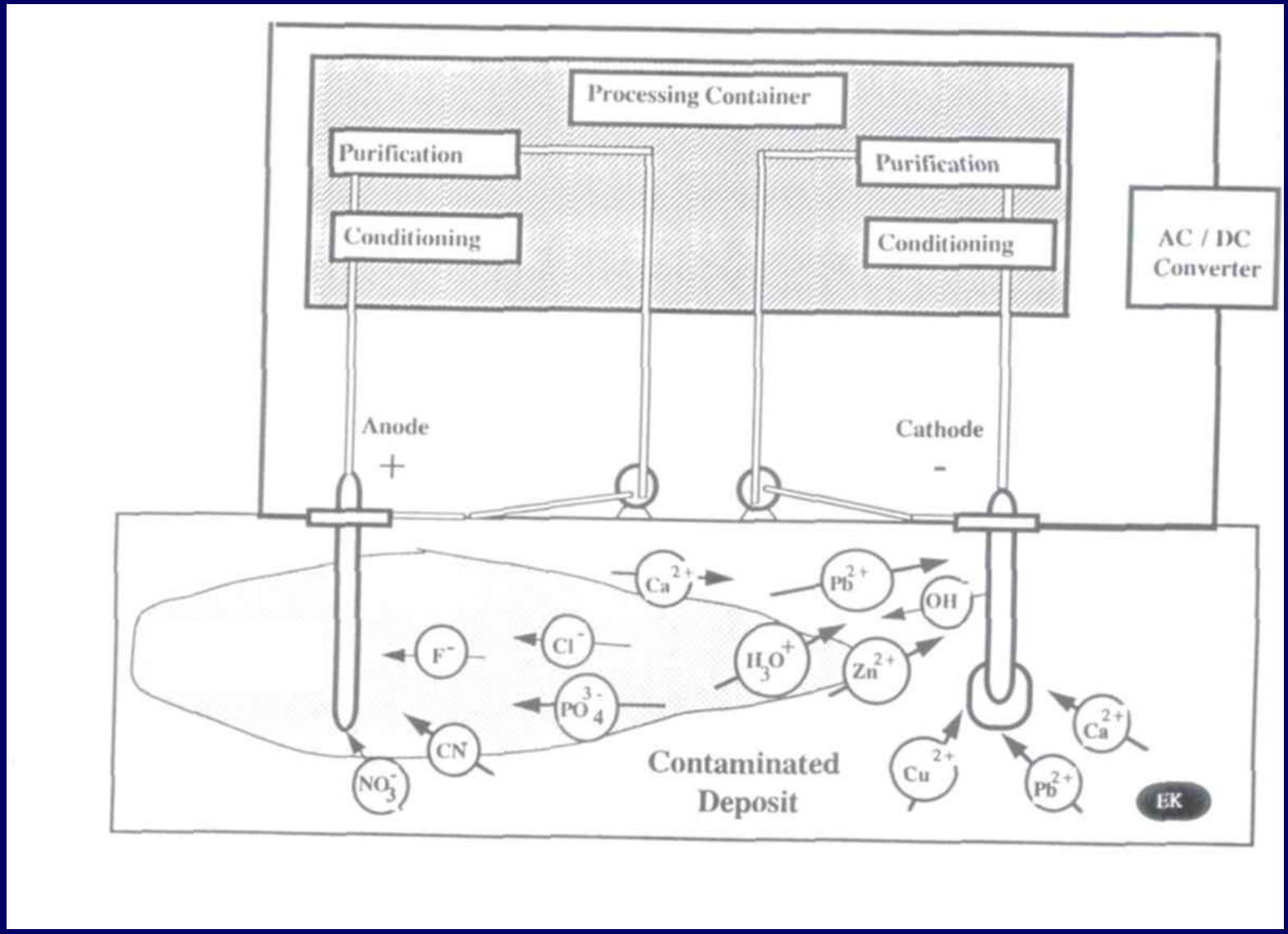

VIT, Inc.
Vitrification
Miscellaneous Solids
Contaminated soils
Solutions, Sludges
Off-Gas Clear-up
Recycle
Commercial Products from Waste
Oxidation Air
Energy Recovery
Exposed aggregate panels
Monument Blocks
Waste Feed System
Hazardous Wastes
Roofing Tiles
Cobbel of sidewalk or street
Parking bumpers
Jersey Barriers
Patio Stones
Grade Level
Glass Forming System
Low Cost PermaVIT Melter
Aggregate or grit blasting sand
Retaining Walls

Retech, Div. of Lockheed Env. Sys. & Tech.

Vitrification




Geosafe Corporation
Vitrification
Backup Off-Gas System
Off-Gas Treatment
Thermal Oxidizer (Option)
Electrode
Quench
Dewater
Heat
Filter
Scrub
Power Supply
Off-Gas Hood
Glycol Cooler
Carbon Absorb. (Option)
Clean Backfill
Secondary Waste Recycling to Future Melts
Vitrified Monolith
Melt
Contaminated Soil



Electrokinetic remediation