BIOLOGICAL TREATMENT OF EXHAUST GASES

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SUSTAINABLE GROWTH

REDUCE ENVIRONMENTAL FOOTPRINT

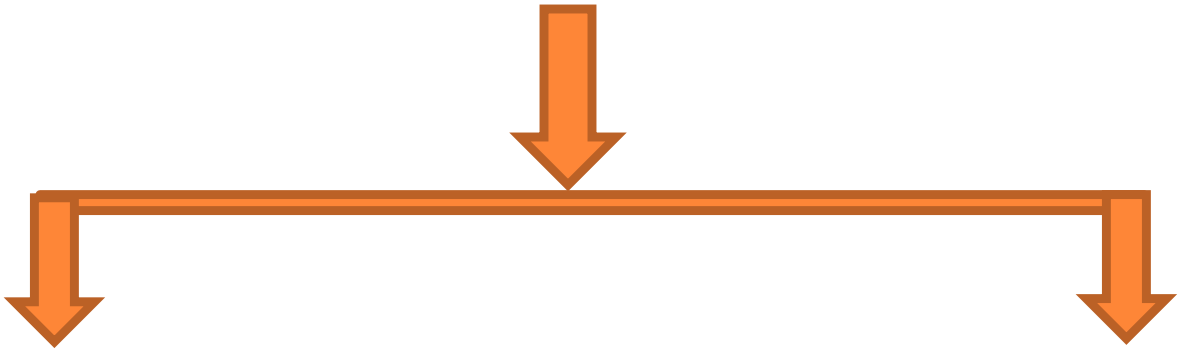
Energy Consumption

Water Usage

Greenhouse Gas Emission

Chemical Emissions

AIR TOXIC EMISSIONS



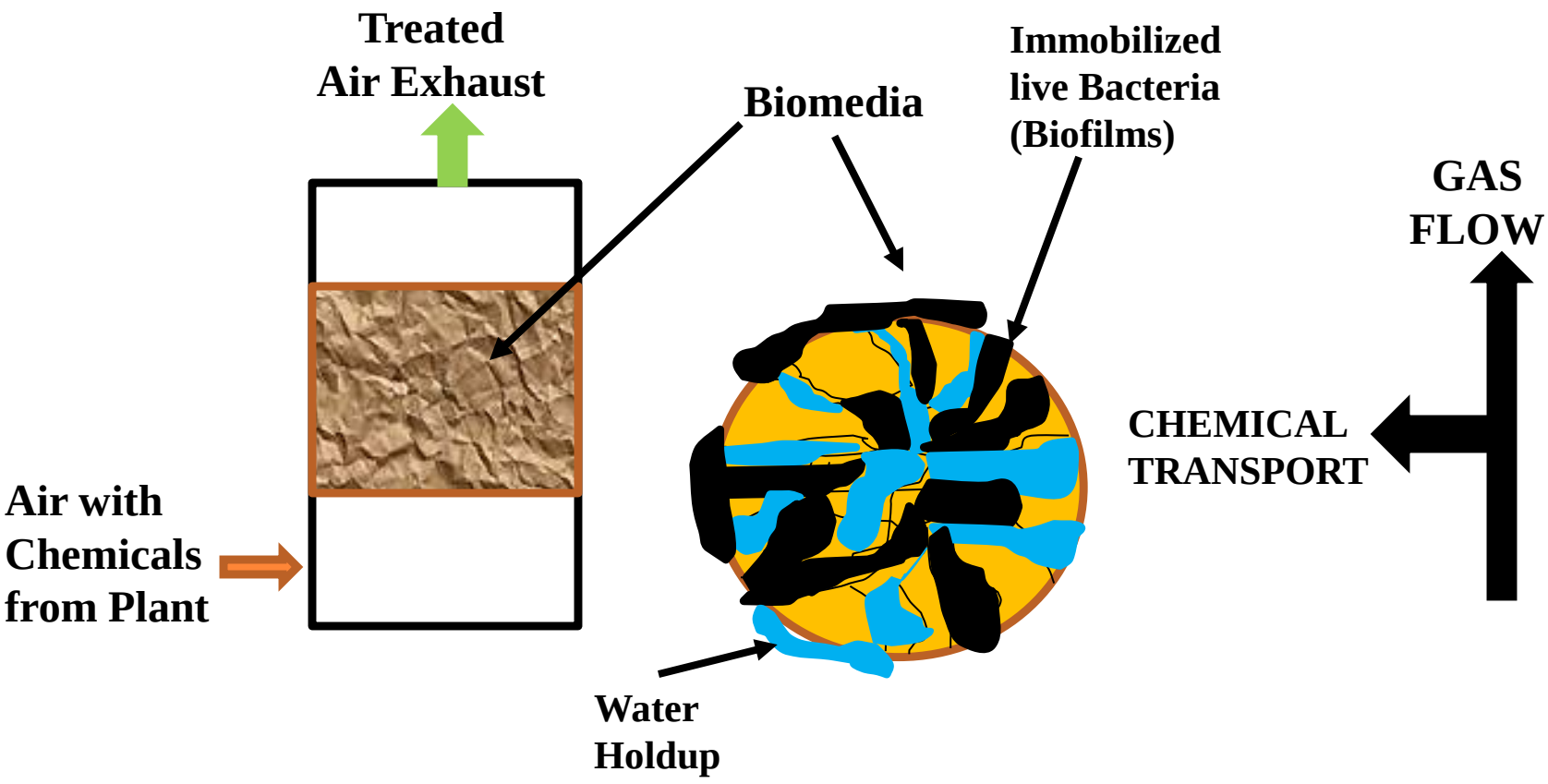
THERMAL DESTRUCTION

- Natural Gas Consumption to raise temperature
- Substantial emission of CO_2 ➔ Greenhouse Gas
- Possible formation of toxic By-products
- High Operating Cost

BIOLOGICAL DESTRUCTION

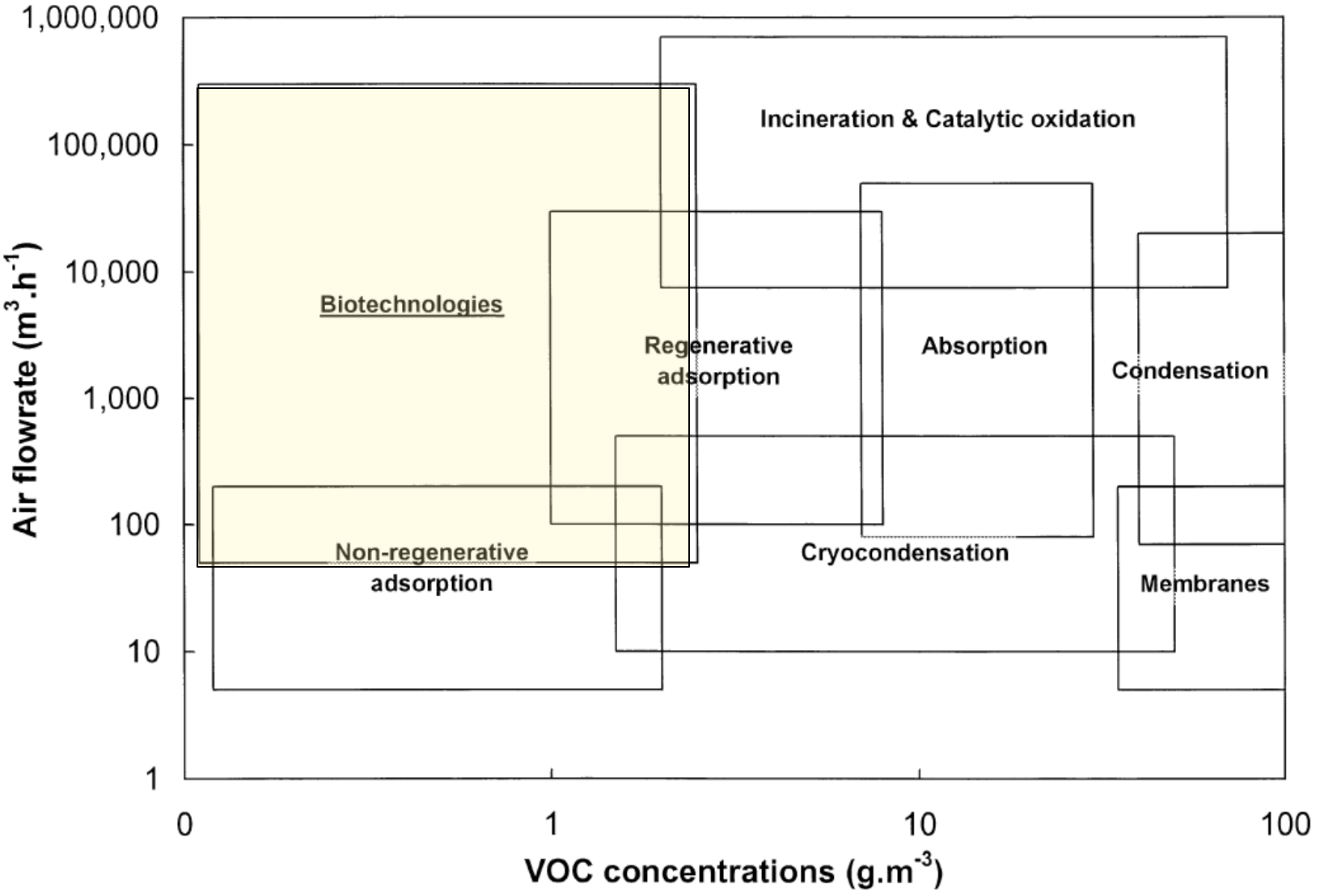
- No consumption of Natural gas
- Low emission of CO_2
- No toxic by-product formation
- Low investment and operating costs

BIOFILTRATION
TECHNOLOGY OF THE FUTURE FOR AIR TOXIC EMISSIONS



AIR FLOWRATE vs VOC CONC.

(VOC – Volatile Organic Compound)



TYPICAL BIOFILTER PERFORMANCE DATA

Application (Reference)	Contaminant(s)	Loading	Removal	Biofilter Type
Yeast Production Facility *(1)*	Ethanol, Aldehydes	35,000 cfm/500 yd^3 media, 1 g/m^3	Overall VOC reduction of 85%	Media filter
Plastics Plant VOC Emissions Control *(1)*	Toluene, Phenol, Acetone	1,000 m^3/h	80%–95%	Media filter
Pharmaceutical Production *(2)*	Organic carbon	1,000 m^3/h, 2,050 mg/m^3 (5,800 mg/m^3 peak)	>98% first stage, >99.9% overall	Media filter (two-stage)
Artificial Glass Production *(3)*	Monomer methyl methacrylate (MMA), Dichloromethane (DCM)	125–150 m^3/h, 50–250 mg/m^3	Biofilter: 100% MMA, 20% DCM; BTF: 95% DCM	Media filter plus biotrickling filter (BTF) in series
Hydrocarbon Emissions Control *(1)*	Hydrocarbon solvents	140,000 m^3/h, 500 mg/m^3	95%	Media filter
Compost Plant for Garbage *(4)*	Odor	16,000 m^3/h, 264 m^2 (1 m deep) 60 $m^3/m^2 \cdot h$, 230 mg C/m^3	>95%	Media filter
Gasoline VOCs Emissions Control (Pilot Scale) *(5)*	Total VOCs	16 $g/ft^3 \cdot h$	90%	Media filter
Hydrogen Sulfide Emissions Control (Laboratory Scale) *(6)*	H_2S	1.9–8.6 mg/kg•min (25–2,651 ppmv)	93%–100%	Media filter
Styrene Removal (Bench Scale) *(7)*	Styrene	Up to 22 $g/m^3 \cdot h$, 0.5 min retention time	>99%	Biotrickling filter
Styrene Removal (Bench Scale) *(7)*	Styrene	Up to 100 $g/m^3 \cdot h$	>95%	Media filter (peat)
Rendering Plant *(8)*	Odor	1,100 m^3/h (650 cfm), 420 m^2 (4,500 ft^2)	99.9%	Media filter
Fuel-Derived VOC Emissions Control *(9)*	Nonmethane organic carbon (simulated jet fuel)	500 ppm•cfm/ft^2, 500–1,500 ppm•cfm/ft^2	>95% 30%–70%	Media filter

COST COMPARISON

TECHNOLOGY	TREATMENT EFFICIENCY	INSTALLED CAPITAL COST	ANNUALIZED OPERATING COST
Methanol, 100 ppmv, 100,000 scfm			
BIOFILTER	95%	$962,500	$204,743
CONC/CO	95%	$1,405,000	$296,767
COC/TO	95%	$2,987,000	$757,085
RTO	95%	$1,905,000	$963,290
Toluene, 30 ppmv, 100,000 acfm			
CONC/CO	95%	$1,385,000	$286,829
CONC/TO	95%	$1,472,600	$350,289
BIOFILTER	95%	$678,200	$120,200
CONC/RTO	95%	$2,110,000	$597,000
RCO	95%	$2,500,000	$633,791
RTO	95%	$1,600,000	$822,600

Note: RCO: Regenerative Catalytic Oxidizer;
RTO: Regenerative Thermal Oxidizer;
CONC/CO: Concentrator plus Catalytic Oxidizer;
CONC/TO: Concentrator plus Thermal Oxidizer;
CONC/RTO: Concentrator plus Regenerative Thermal Oxidizer

COMPOUNDS THAT CAN BE TREATED BY BIOFILTRATION

TYPE OF CHEMICAL	BIODEGRADABILITY	TYPE OF CHEMICAL	BIODEGRADABILITY
Aliphatic Hydrocarbons	1-2	Amines	3
Aromatic Hydrocarbons	2-3	Nitriles	1
Chlorinated Hydrocarbons	1	Alcohols	3
Aldehydes	3	Esters	3
Inorganic Compounds	3	Hydrogen Sulfide	3
Nitrogen oxides	1	Ketones	3
Sufur compounds	1-2	Terpenes	1-2

Note: <u>Biodegradability Numbers</u>

Low Biodegradation Rates: 1
Moderate Biodegradation Rates: 2
High Biodegradation Rates: 3

CONCLUSIONS

- **Biofiltration is an effective treatment technology that has been successfully applied for treating air emissions of a wide variety of chemicals**
- **Biofiltration has several advantages over thermal destruction, especially in terms of lower investment and operating costs, low energy consumption, and substantially less carbon dioxide emissions**
- **Recent developments in Biofiltration have resulted in the use of synthetic biomedia, as compared to natural media, such as compost, wood chips, which has resulted in smaller footprint and increased treatment efficiency**
- **Biofiltration is an effective air pollutant treatment technology that can be applied corporate-wide to enhance sustainability while increasing product diversity and production and increasing profit margins**