

Eighth Annual Conference on Carbon Capture & Sequestration

Solvents

No Escape for CO₂ BASF's Development Program for Post Combustion Capture

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BASF well positioned to take on the challenges of carbon capture

- **More than 40 years of experience in removing CO₂ from synthetic and natural gas streams**
- **Extensive R&D facilities for the development of gas treating technologies and new chemical compounds**
- **One of the world's leading suppliers of amines with broadest product portfolio**
- **Comprehensive knowledge to scale up processes from lab scale to full industrial production**

Major contributing cost factors

Capture Plant

Equipment size

Process configuration

Material of construction

Power plant integration

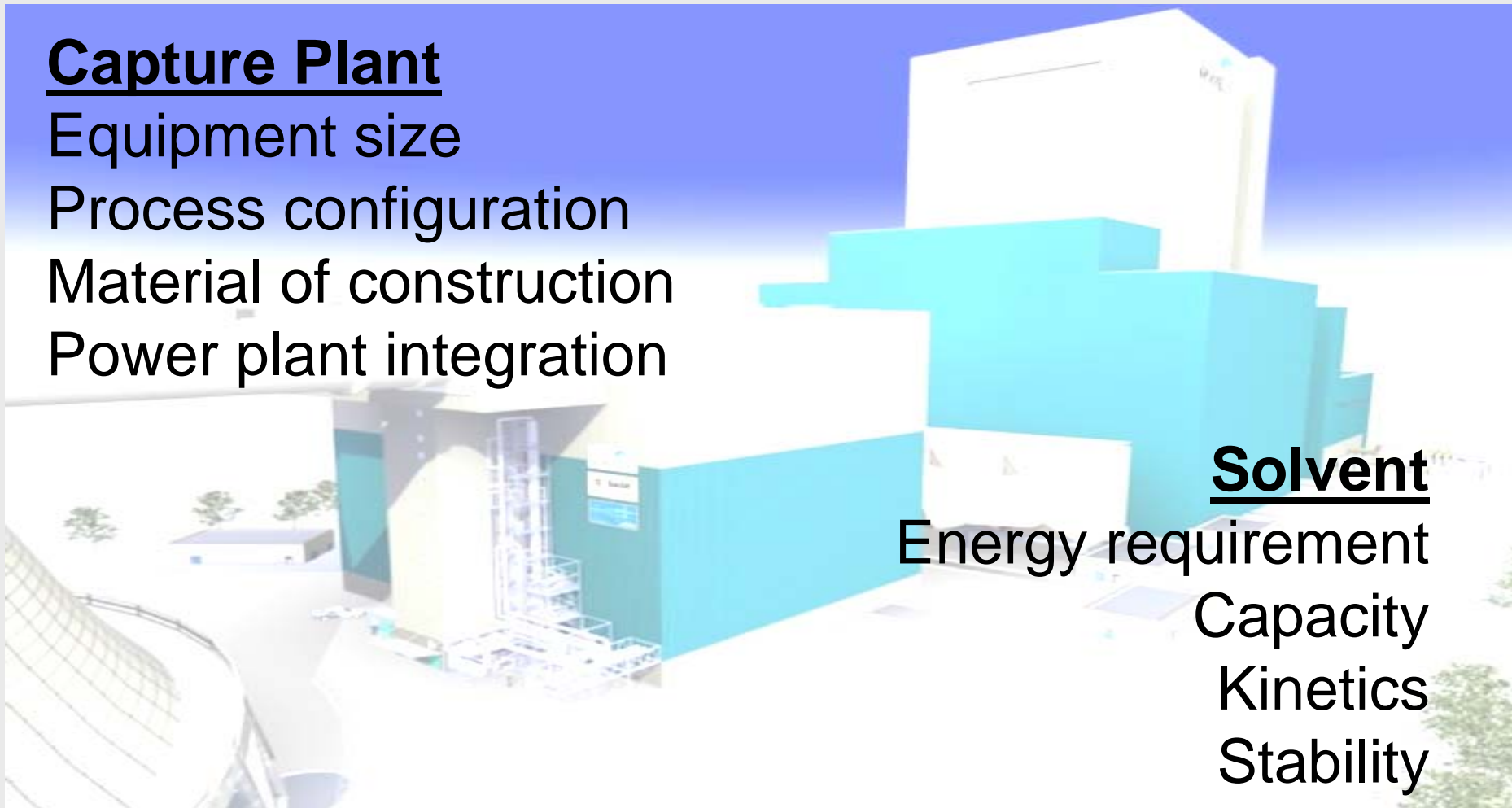
Solvent

Energy requirement

Capacity

Kinetics

Stability



Objectives of BASF's development program

Solvent	MEA (30%)	NoEscape
Power plant efficiency loss	12-14%	<< 10 %
CAPEX	100 %	80 %
Product losses	1.6 – 3.0 kg/t _{CO2}	<< 0.4 kg/t _{CO2}

Selection criteria for solvent of choice

- **Physical, chemical and toxicological properties**
- **Energy efficiency**
- **Mass transfer of carbon dioxide and kinetics**
- **Solvent losses and solvent stability**
- **Compatibility with construction material**
- **Large scale production**

The long road to success

Product portfolio, databases

~ 400 Substances

Pre-selection

Molecular weight, Vapour pressure, Alkalinity, Safety data

~ 180

Screening

Phase equilibria, Reaction kinetics, Stability

~ 10

Verification

Mini plant

2

Litmus Test: Pilot Plant

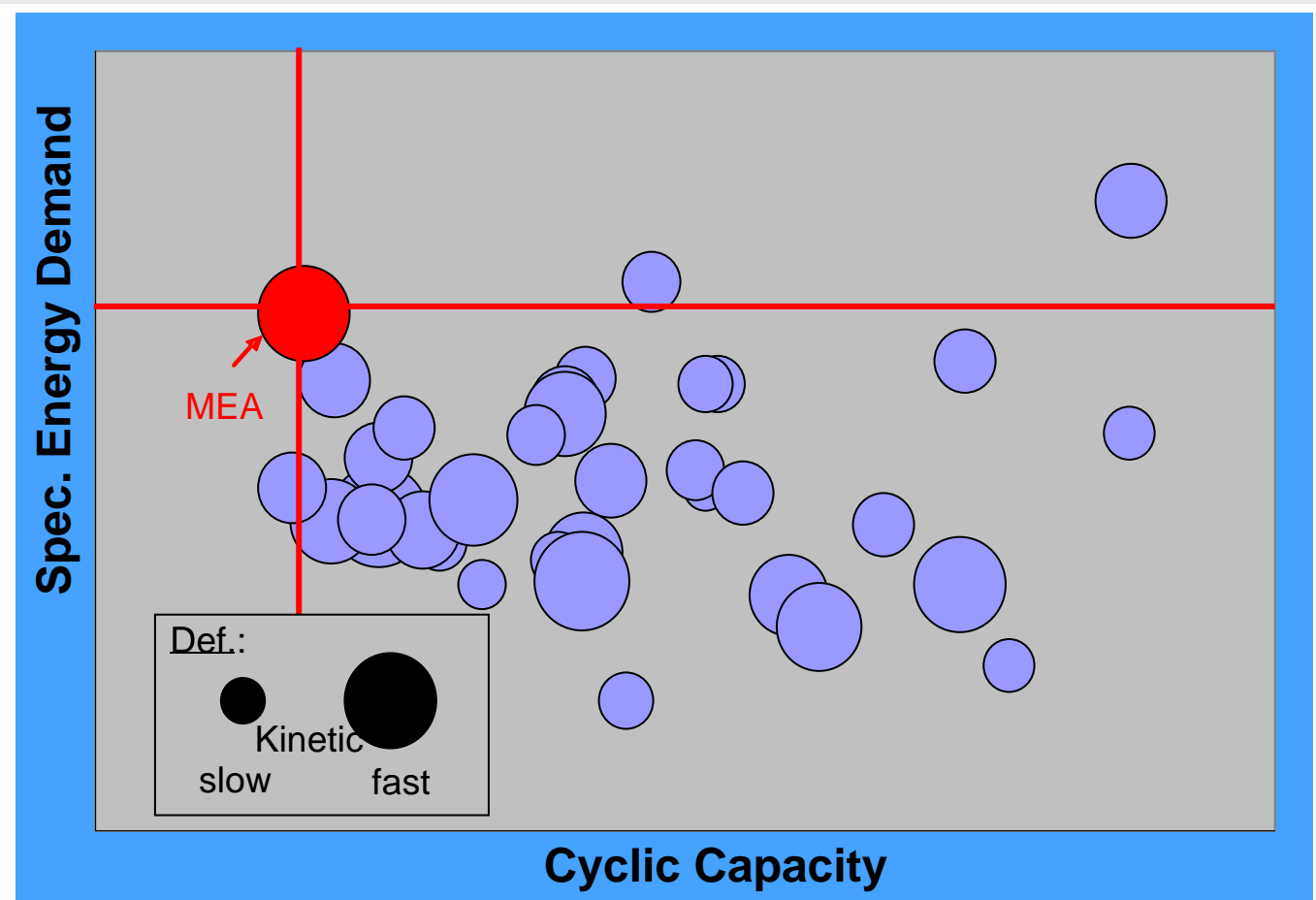
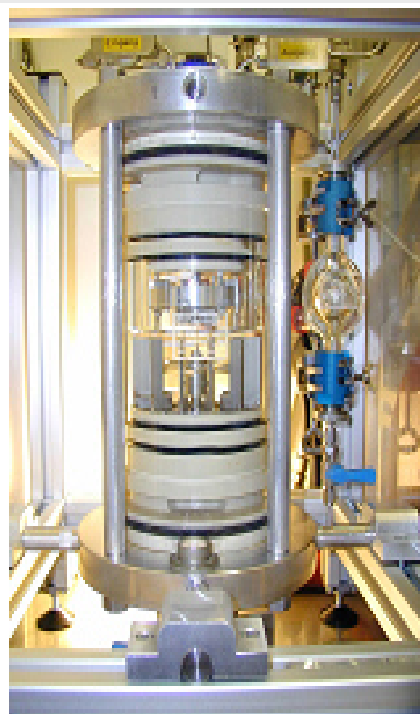
Discontinuous
synthetic gas

Continuous
synthetic gas

Continuous
slip stream

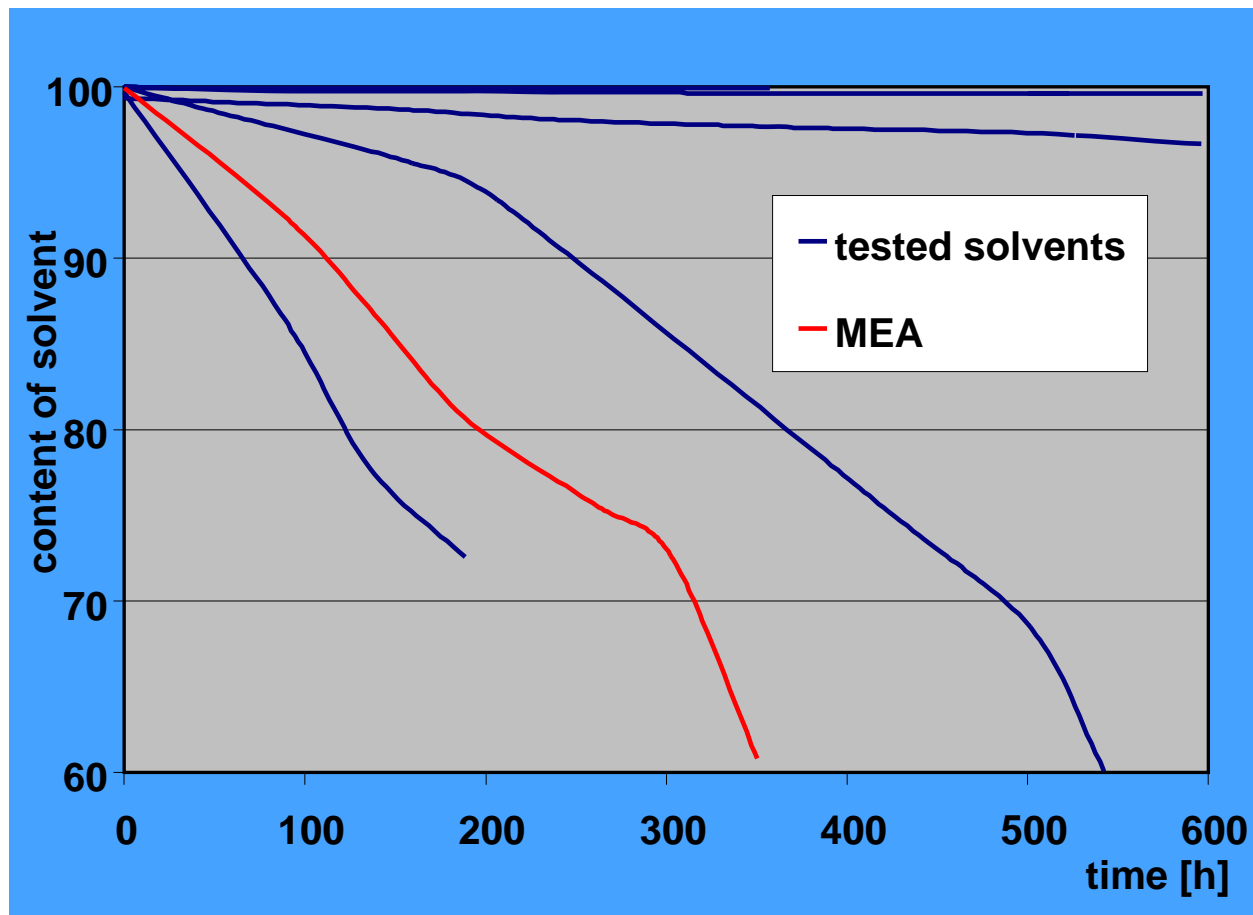
Summary of screening phase capacity, energy, kinetic

'Double stirred' contactor cell



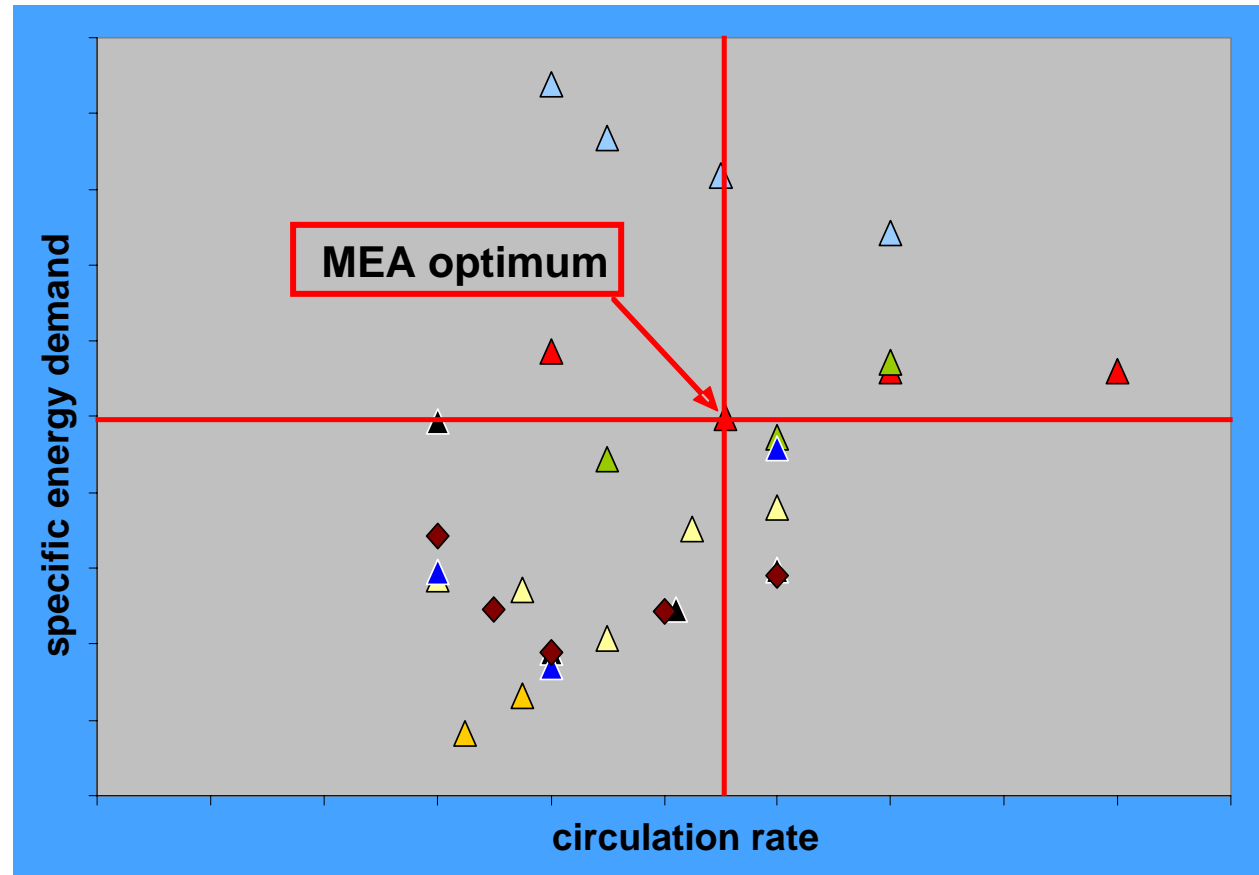
Solvent stability towards Oxygen

‘Stress’ tests
using air



Verification in mini plant

Mini plant at BASF



Summary and Outlook

- **Meticulous search and comprehensive testing ultimately paid off**
- **A handful of solvents identified which have potential to meet the objectives of the development program**
- **Most promising candidates subject to pilot testing using slip stream starting July 2009 (part of co-operation with RWE and Linde)**
- **Results expected early 2010 to confirm mini plant data and to gain in-depth understanding for future scale up**