ACT Knowledge Workshop Rotterdam 2022

Project Overview and Results

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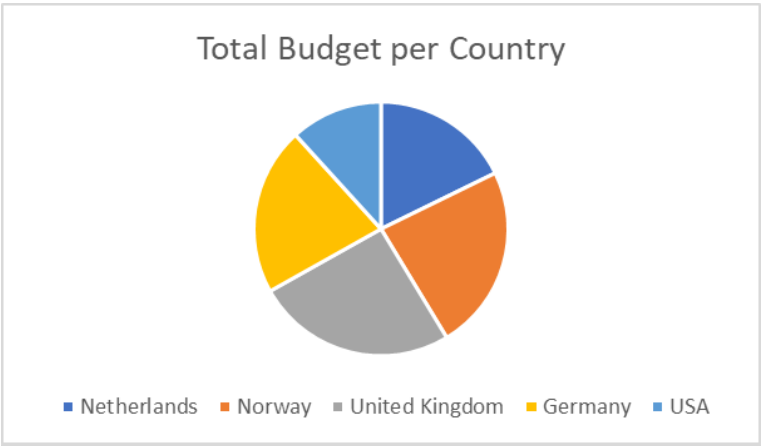
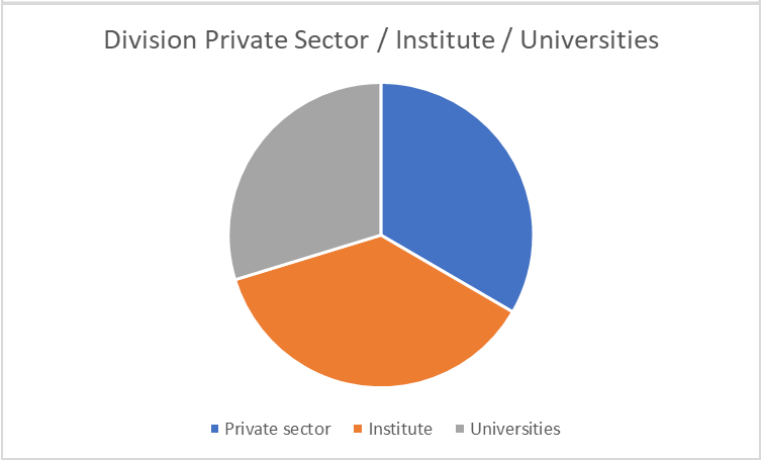
9 June 2022

The LAUNCH Project

Lowering Absorption process UNcertainty, risks and Costs by predicting and controlling amine degradation

- 11 partners from NL, UK, DE, NO, USA
- Total budget: € 7.248.625
- Total funding: € 5.090.849

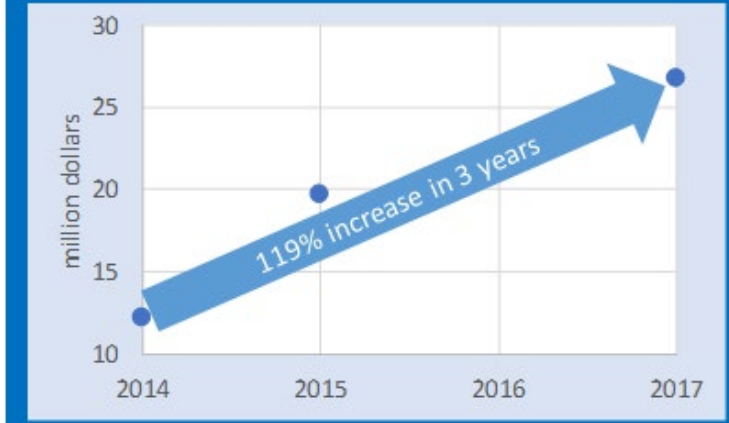




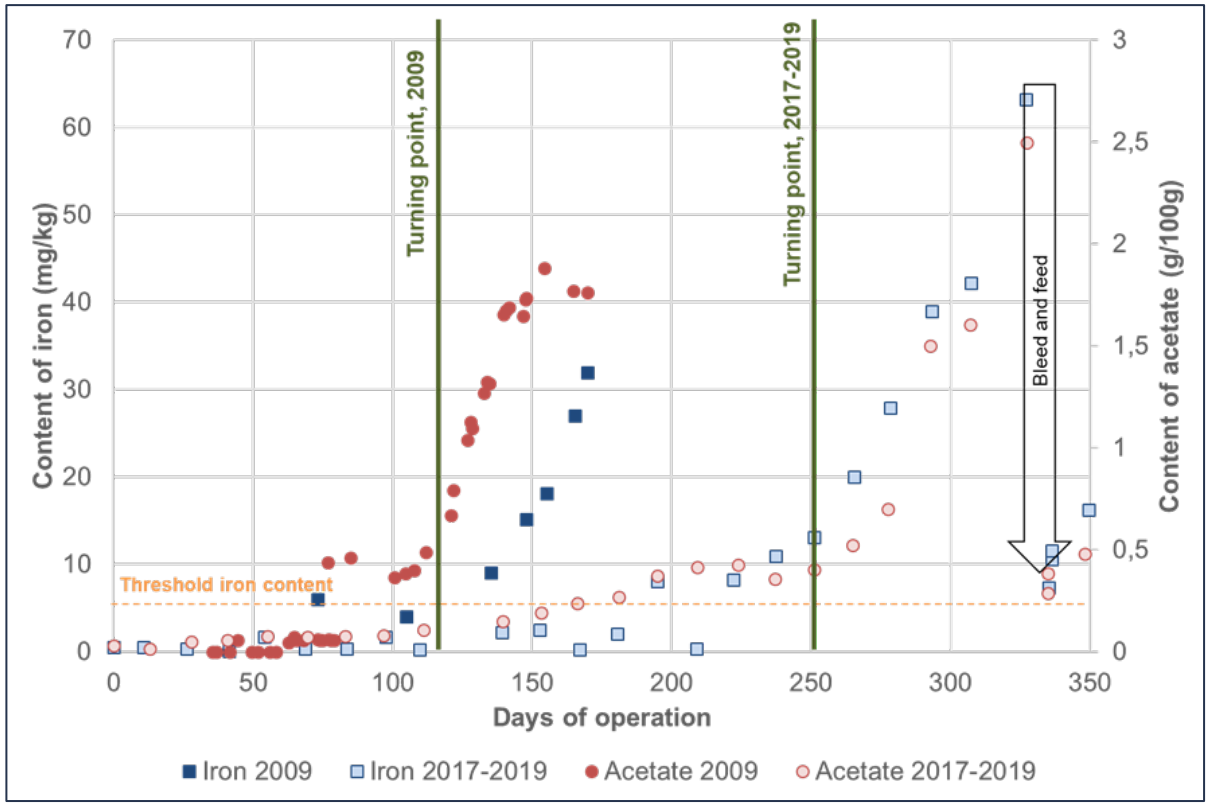
The ISSUE LAUNCH want to tackle

The costs of degradation – A real-life, full-scale example

The CCS facility at Boundary Dam Three (BD3), is a real-life full-scale example of how costly degradation can be. BD3 has reported that the costs of operation and maintenance are much higher than anticipated, because the solvent degrades more quickly than expected [25]. As a result, the BD3 operation and maintenance costs have risen from $12.2 million in 2014 to $26.7 million in 2017 [26].

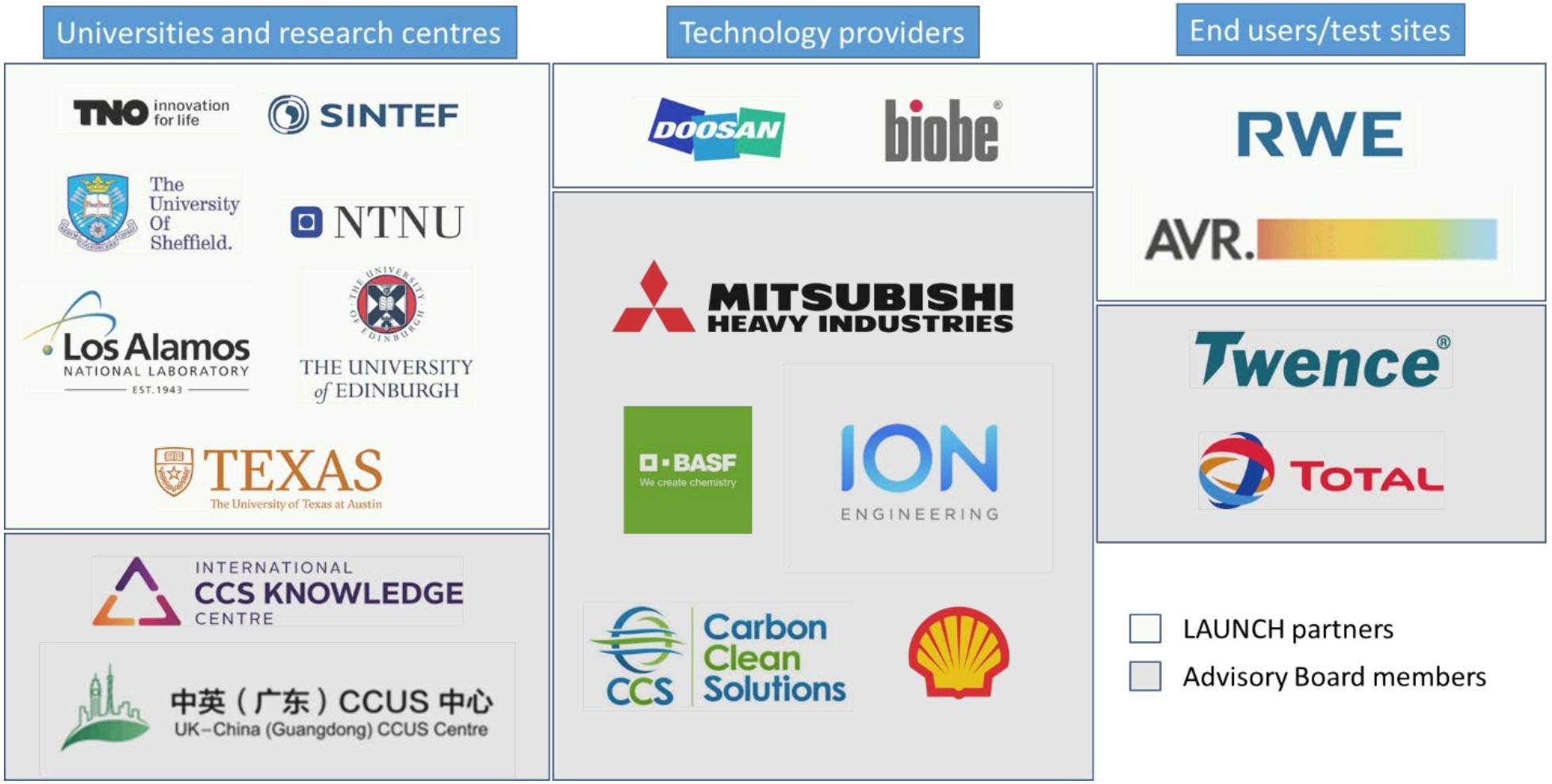


BD3 operation and maintenance costs



The results of the MEA campaign at the RWE pilot plant in Niederaussem within the ALIGN project. The "turning point" of the **first campaign was 100 days of operation in contrast to 250 days in the second campaign**.

The LAUNCH Consortium



The LAUNCH GOAL

Development of **The LAUNCH Solvent Development Protocol**
→ This protocol will be made **public**.

This protocol will include guidelines for:

LAUNCH-developed solvent degradation database

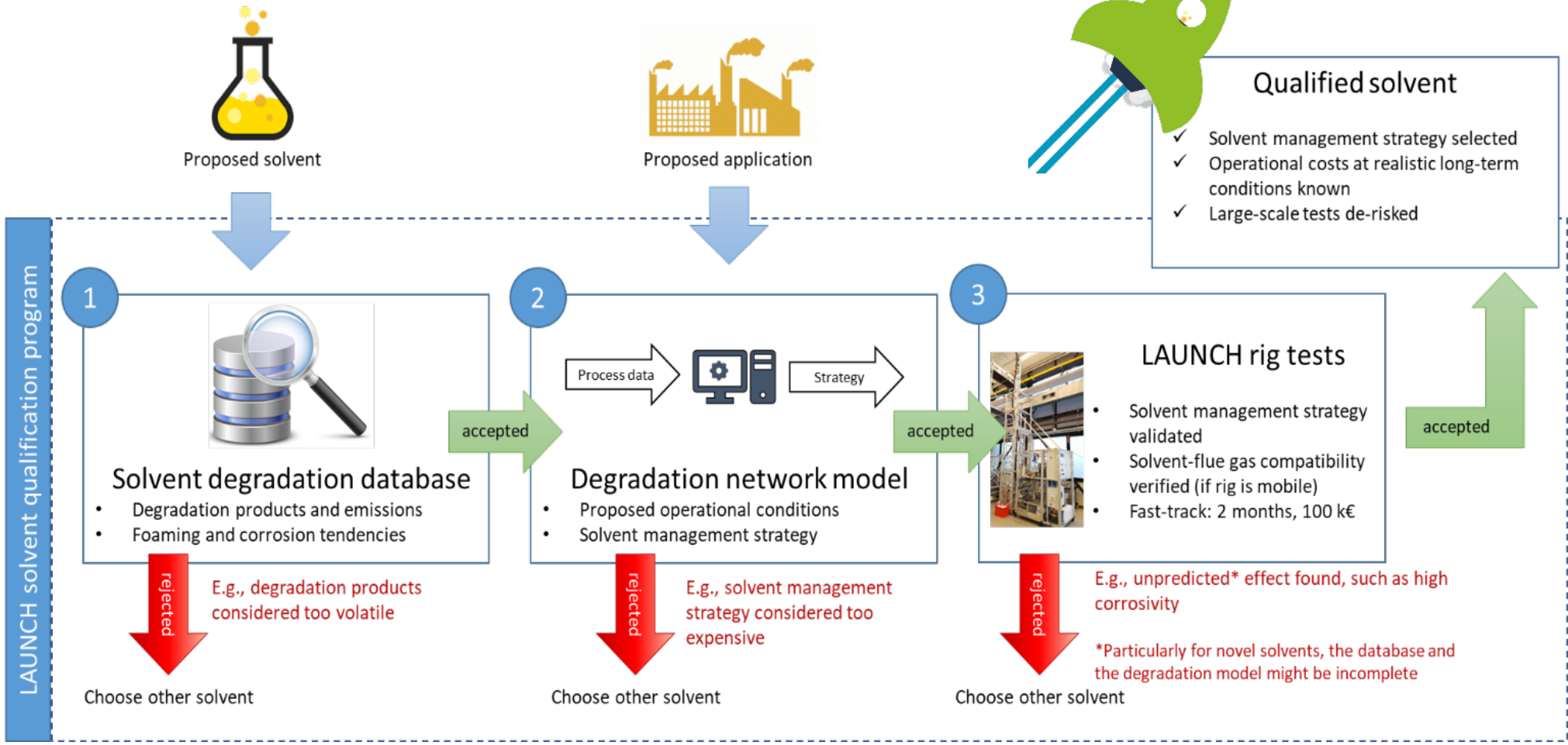
LAUNCH-developed degradation network model

Solvent testing and the drawings of a generic LAUNCH test rig

Work packages in LAUNCH

	Name	Participants (**Leader**)
WP1	Predicting degradation Andreas Grimstvedt	**SINTEF IND**, NTNU, TNO, RWE, DOOSAN, UnivShef
WP2	Controlling degradation Roberta Figueiredo	**TNO**, LANL/UT, RWE, Biobe, NTNU
WP3	Closing degradation knowledge gaps Hanna Knuutila	**NTNU**, SINTEF IND, LANL/UT
WP4	Development of LAUNCH solvent qualification program Jon Gibbins	**UnivShef**, TNO, SINTEF IND, NTNU, LANL/UT, DOOSAN, UEDIN
WP5	Demonstration of LAUNCH solvent qualification program Peter Moser	**RWE**, AVR, LANL/UT, TNO, NTNU, UnivShef
WP6	Techno-economic evaluation Jonathan Slater	**DOOSAN**, TNO, RWE, BIOBE
WP0	Management, dissemination and exploitation Peter van Os / Juliana Monteiro / Philippa Parmiter	**TNO**, SINTEF IND, NTNU, UnivShef, UEDIN, RWE, DOOSAN

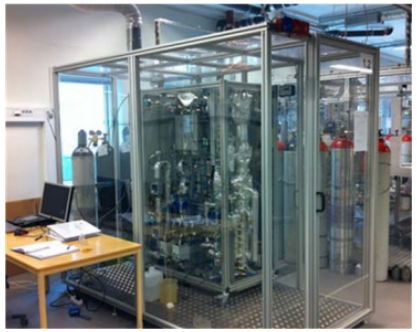
LAUNCH Solvent Qualification



LAUNCH Test Facilities

Demonstration by experiments at multiple scales:

- The LAUNCH rigs (up to 25 kgCO2/day)
- PACT
- RWE pilot
- AVR full scale plant
- NCCC test facility



LAUNCH rig#1 (SDR rig at SINTEF)

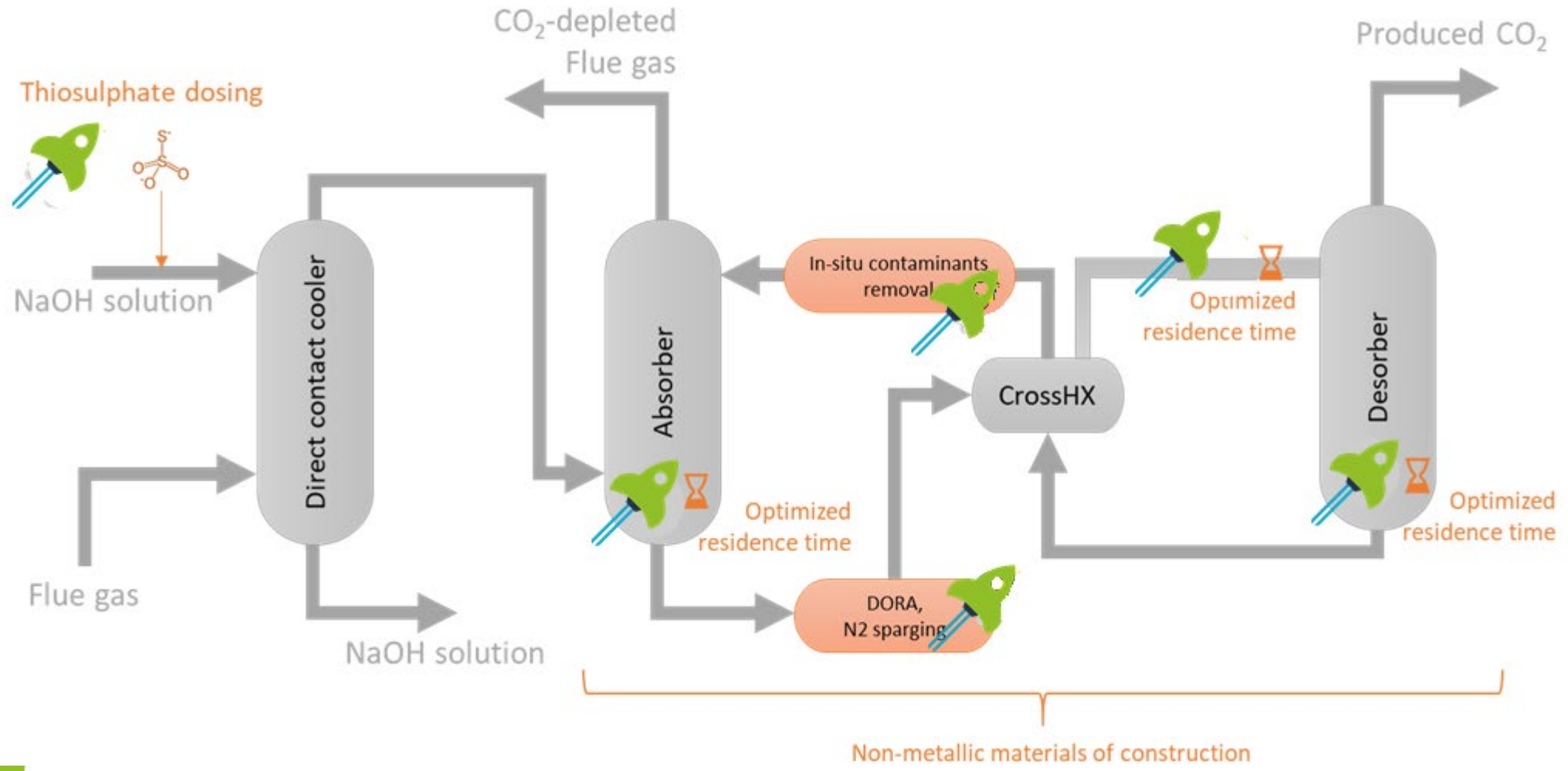
LAUNCH rig#2 (Miniplant at TNO)

LAUNCH rig#3 (Non-metallic plant at TNO)

ASAP rig at UoT

HTOR rig at UoT

LAUNCH Technology Development



Issues / COVID-19 Impact

The PACT facility was flooded in November 2019. PACT has now being moved to another location and rebuild as TERC. Testing completed, processing results ongoing.

On site Mini plant campaigns at RWE and AVR delayed. RWE campaign completed, AVR campaign planned for this summer.

Six months extension requested and granted by ACT

LAUNCH Predicting Degradation

Public available data base

The **Dataverse database** and web portal are operational. It will be **publicly accessible** after the end of the project.

Process modelling

Data on Oxygen depletion experiments, Accelerated degradation tests and Launch Rig comparison are used to develop **the Degradation Network Model for MEA and CESAR1.**

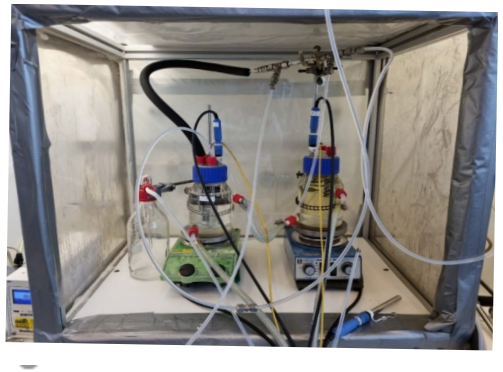
Big data modelling

Open source **Python used for analysis.** Degradation Network Model will be validated with process data from AVR (MEA) and RWE (CESAR1).

LAUNCH Controlling Degradation

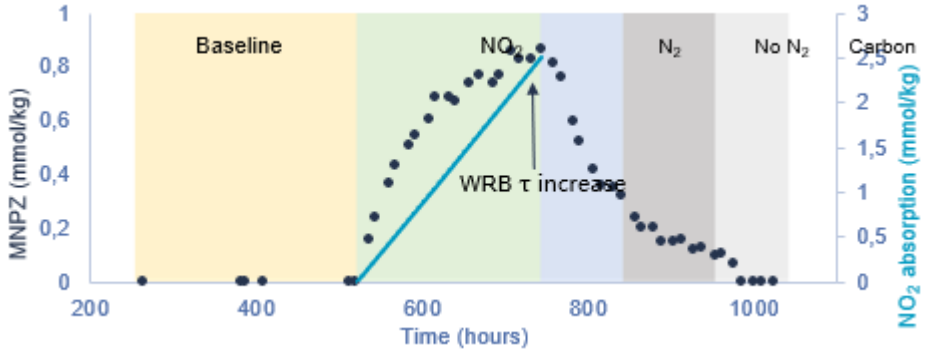
Oxygen Removal (DORA)

Tests with various solvents (MEA, CESAR1, MDEA-PZ) in Oxygen Depletion Installation (ODIN) with the DORA membrane. **New membrane from NTNU tested**. Dedicated person hired to increase test capacity.



Oxygen Removal (N_2 sparging)

100% Oxygen removal shown in tests at University of Texas. Model will be updated before continuing experiments.



Non-Metal Plant

Non metal plant constructed and commissioned. Controlled addition of iron is foreseen. Unfortunately the plant had a malfunction with a seal that is leaking. New (other type seal) ordered.

LAUNCH Controlling Degradation

Role of metals in degradation

Metal-free lab reactor designed at UT to test different metals **(**Fe, Mn, Cr, and Ni) as oxidation catalysts.

A variety of **ion exchange resins have been tested** for iron removal. One **optimal resin was selected**.

Role of iron in degradation **(either catalyzes or directly participates in the oxidation)** still under investigation.

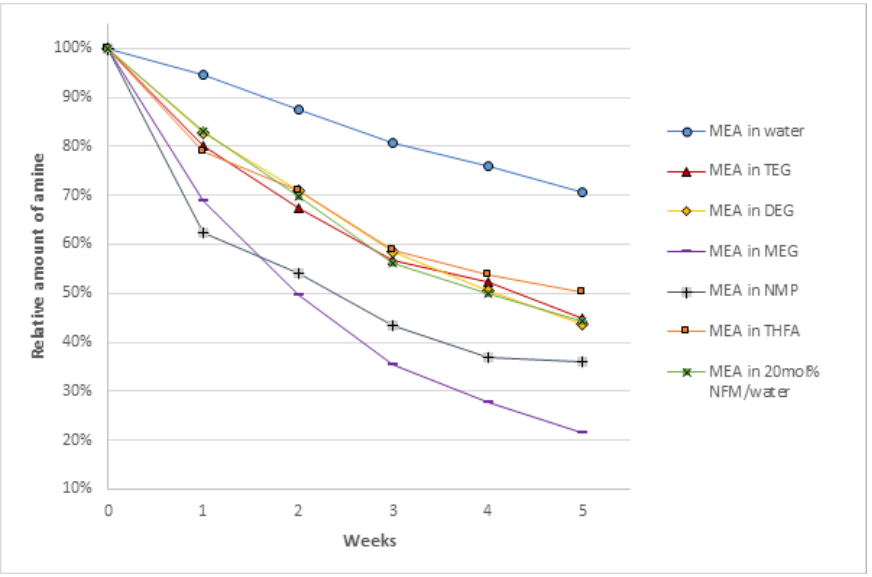
LAUNCH Closing Knowledge Gaps

Behavior of 2nd and 3rd generation solvents

Tests with **second and third generation solvents** for corrosion and foaming behaviors.

Thermal and oxidative degradation

Compare the thermal and oxidative degradation of second and third generation solvents to well-known solvents.



Method development

Development of analytical methods for **fast and cost-effective identification of degradation compounds** and main volatile degradation compounds.

Development of LAUNCH solvent qualification program

Qualification of LAUNCH rigs

Compare TNO's mini plant campaign with campaign at TERC with similar settings. Campaign TNO completed in 2022, campaign at TERC delayed due to flooding but finished. Data processing ongoing.

Accelerated degradation tests including mitigation

Accelerated degradation tests (high concentration MEA, increased oxygen levels, increased regeneration temperatures and addition of NO2) **completed** at TNO and TERC. Data processing ongoing combined with modeling work in WP1.

Protocol for accelerated degradation tests

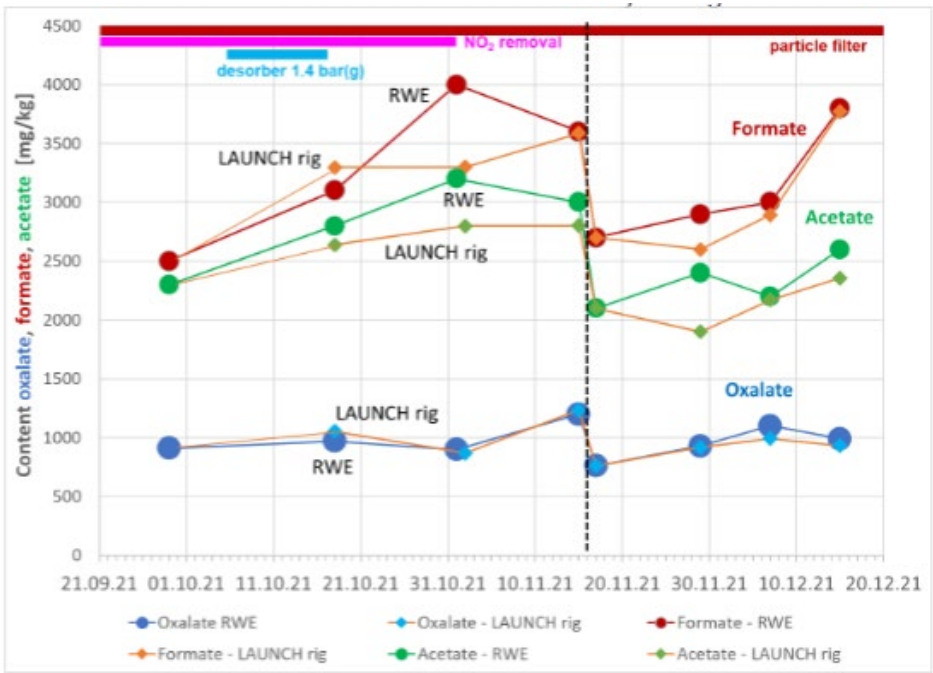
Results will be discussed in the technical meeting at RWE in Niederaussem to define the protocol.

Demonstration of the solvent qualification program

Head to head comparison

A **CESAR1 campaign was run with TNO mini plant next to the RWE pilot plant** to compare degradation profile (completed). Subsequent testing at AVR in August 2022 for MEA.

Video available at: **https://launchccus.eu/news/little-and-large-tale-two-cutting-edge-co2-capture-plants**

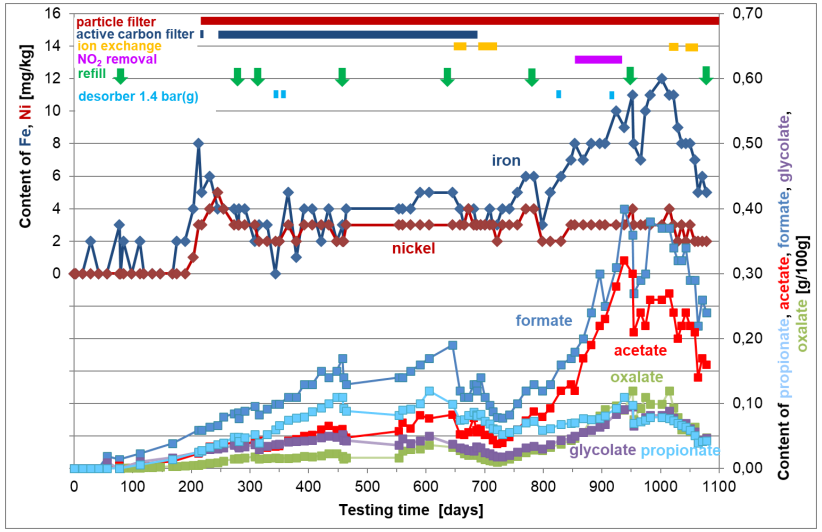


Degradation products comparison

Demonstration of the solvent qualification program

Demonstration of mitigation technologies

Tests at RWE en NCCC (thiosulfate dosing, ion exchange, active carbon, oxygen removal, nitrogen sparging, iron removal with solid adsorbent, thermal reclaiming).
Both test sited are still operating to collect data.



- almost 36 months testing time achieved, approx. 26,000 hours
- Ion exchange campaign ongoing: 16+24 exchange cycles up to now

Demonstration of solvent qualification program

Demonstration of the accelerated degradation protocol and develop a degradation control strategy for solvents. Experimental work is still ongoing at TERC.

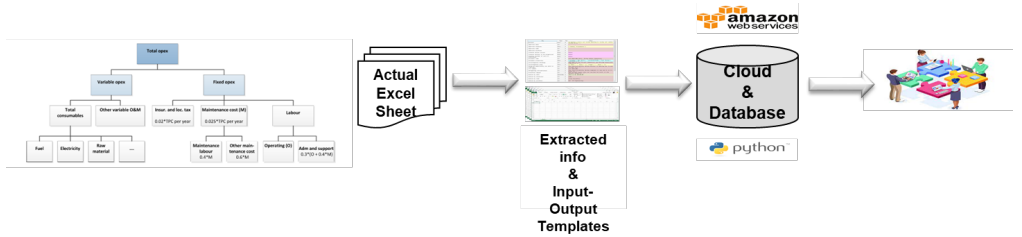
Techno-economical Evaluation

Solvent degradation control options

Cost assessment tool developed by DOOSAN for estimation of CAPEX and OPEX values for commercial-scale installations (also including degradation mitigation technologies).

Cost of solvent development

Estimation of costs to qualify a solvent for CO_2 capture, taking into account all results gained in LAUNCH.
Target: 100 kEuro / 2 months.



Techno-Economical Evaluation

A techno-economic evaluation that categorises a number of solvent degradation control options, highlighting the optimum concepts against agreed benchmarks.

The cost of solvent qualification based on the LAUNCH solvent qualification program will be determined with the target marginal cost set at 100 k€ per solvent.

This will contribute to the acceleration and maturation of CCS technology with respect to solvent degradation management

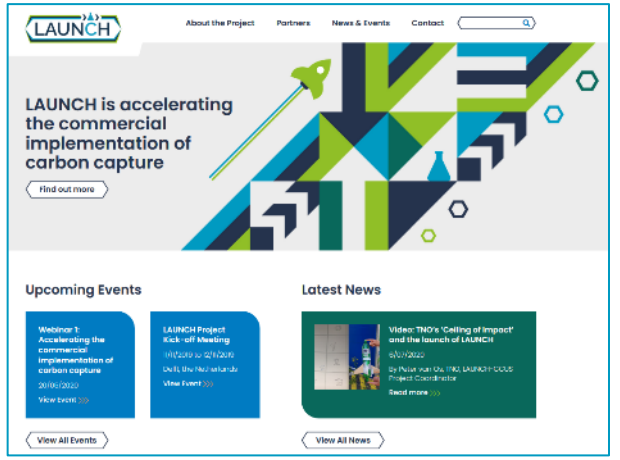
Dissemination activities

Project website: www.launchccus.eu

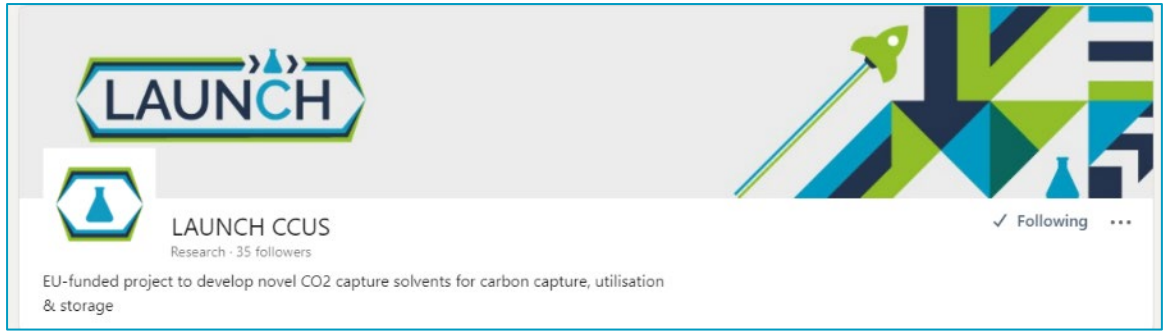
Twitter: @launchccus

LinkedIn: https://www.linkedin.com/company/launch-ccus/

GHGT16 October 2022 (Lyon) Posters and oral presentations



Website



LinkedIn

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Acknowledgements

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Thank you for listening

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