



TECHNOLOGY ADVANCEMENT IN CATALYST LOADING AND TUBE CLEANING FOR REFORMERS



UNIDENSE® Technology GmbH
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GERMANY

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your reformer technology services provider of choice



OUR MISSION

OUR **PRIMARY RESPONSIBILITY** IS TO PROVIDE AND ADD VALUE TO ALL CUSTOMERS

OUR **OBJECTIVE** IS TO DELIVER HIGH QUALITY SERVICES AND ENHANCING SAFE & HEALTHY WORKING ENVIRONMENT

- PROFESSIONALISM
 - FLEXIBILITY
- ABILITY TO BE EVERYWHERE

OUR VISION

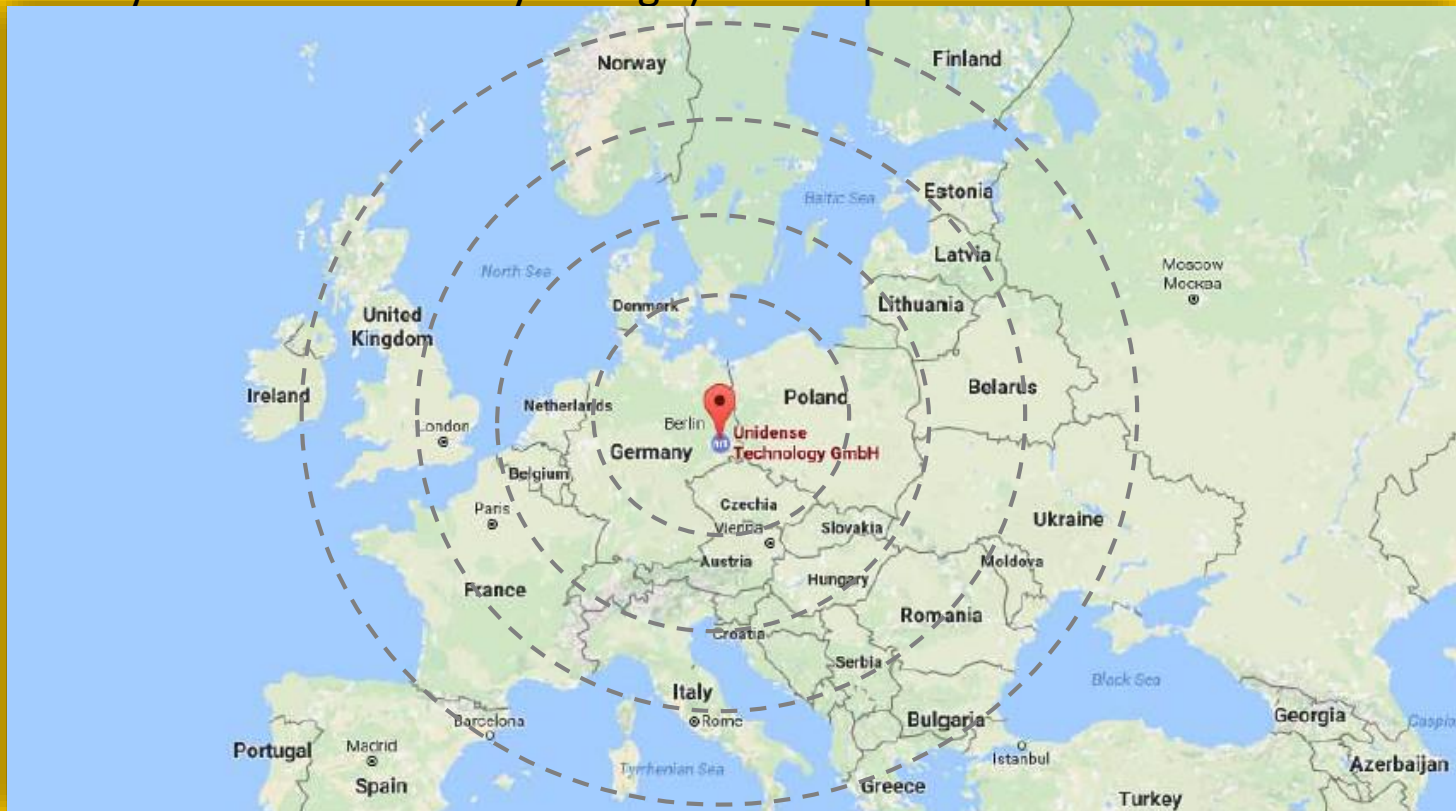
BECOMING A **GLOBAL SPECIALIST** IN REFORMER TUBE TECHNOLOGY SERVICES OF CHOICE



UNIDENSE® Technology GmbH

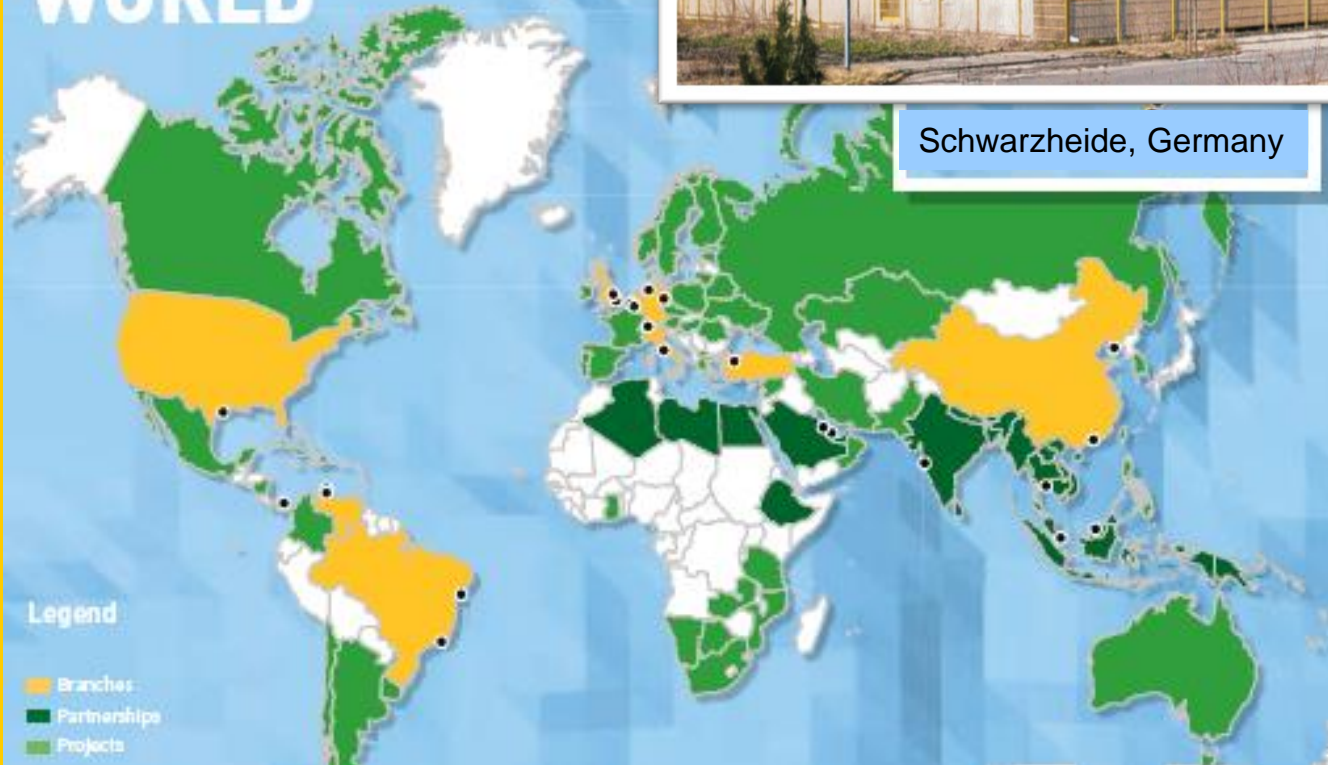
OVERVIEW

UNIDENSE® Technology GmbH was established in 2005 with an office in the center of Europe - Schwarzheide, Germany. UNIDENSE® Technology GmbH was established when the UNIDENSE® patents and business from Yara International (previously known as Norsk Hydro Agri) on 1st April 2005.



BUSINESS OVERVIEW

MOURIK ON THE MAP OF THE WORLD



Schwarzheide, Germany

INTRODUCTION

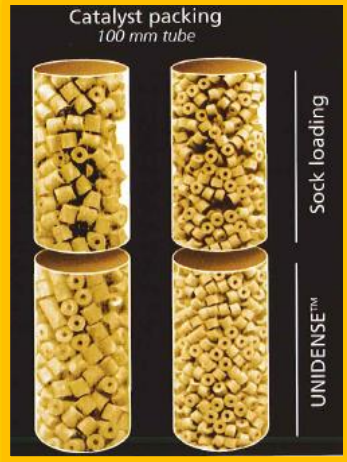
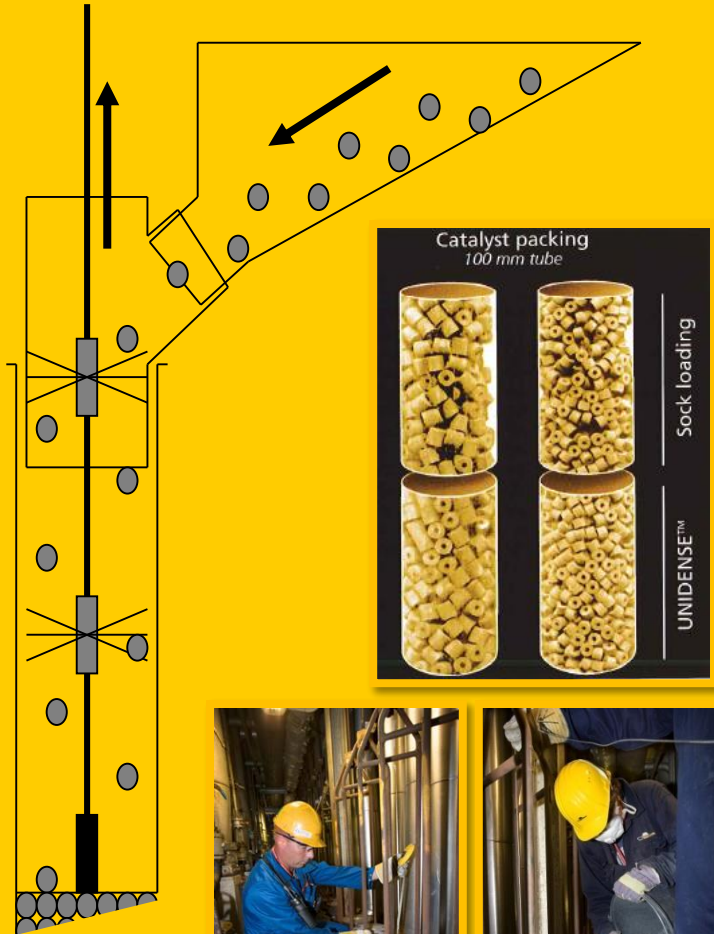
- UNIDENSE® is the most utilized trickle loading technique in the market: the technique uses carefully designed springs on cable wire, which are used to give a controlled and uniform loading and positioning of catalyst, minimizing damage, as it is poured into the tubes.
- UNIDENSE® is used to load primary reformer tubes in ammonia, methanol and hydrogen plants (syngas market). Reformers with up to 1000 tubes with an internal tube diameter from 70 mm (2,8") to 250mm (10").
- Norsk Hydro Agri developed the technique - since 2005 the patent is owned by UNIDENSE® Technology GmbH. Later this patent is followed by the UNILOADER®.

LOADING USING "SOCKS"

- Require separate steps to fill the socks with catalyst,
- Takes 25 minutes per tube,
- Less uniform loading,
- However, it provides lower quality results

LOADING USING UNIDENSE®

- Significantly quicker than traditional sock loading,
- More homogeneous pressure drop across the reformer,
- Less need for tube vibration or reloading of catalyst tubes,
- Result in an optimized operating efficiency in the Primary Reformer, achieving uniform process gas exit temperature and methane slip,
- Minimizes potential "hot spots" (achieving a more uniform tube wall temperature).

- Proven patented technique,
- Fast reformer loading,
- No pre-socketing of catalyst,
- No vibration of the tubes,
- Uniform pressure drop,
- Less waste of catalyst,
- No bridging or extra voids;
 - Minimizes hot spots,
 - Reduces catalyst settling
- Higher uniform density;
 - Lower tube walls temperature,
 - Prolonged tube life,
 - Increased reforming process activity

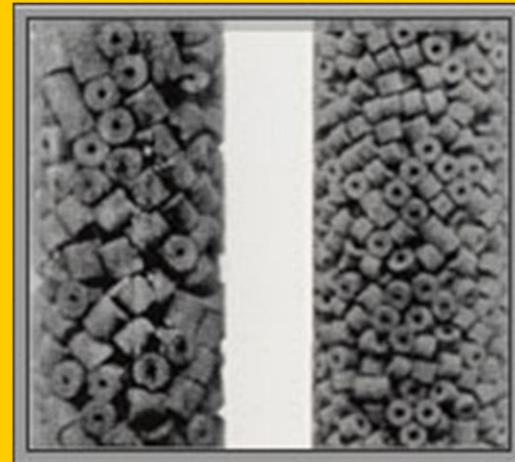


UNIDENSE® Technology

- **PROVEN PATENTED TECHNOLOGY**
 - ✓ Over 1000 UNIDENSE® loadings since 1996.
- **UNIFORM CATALYST LOADING**
 - ✓ 3% to 7% more catalyst with minimum breakage and attrition levels results in an increased reforming capacity,
 - ✓ Average pressure drop $\pm 5\%$ ($\pm 3\%$ = realistic).



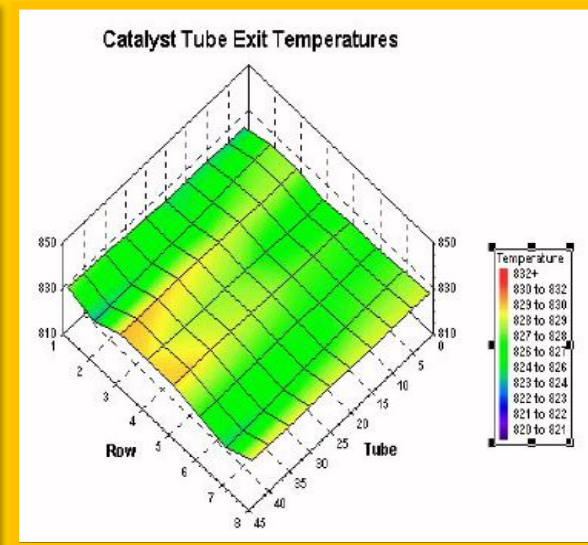
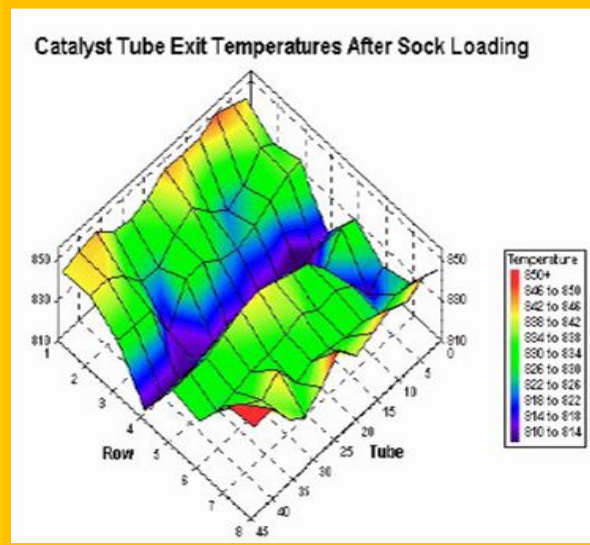
*Sock Loading Method
100 mm tube*



*UNIDENSE® Method
100 mm tube*



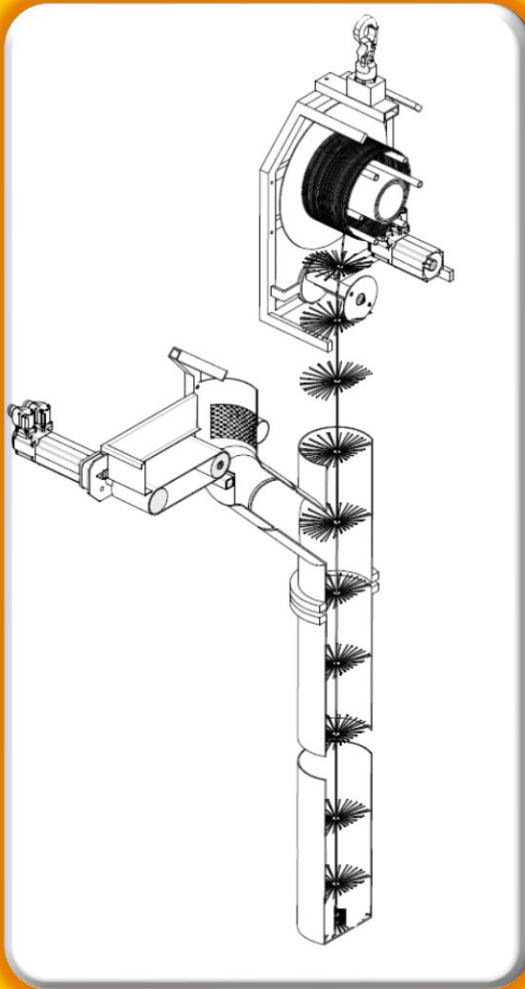
- LESS TEMPERATURE VARIATION
 - ✓ Most efficient conversion of hydrocarbons with minimum methane slip,
 - ✓ Prolonged tube life.



- FAST LOADING
 - ✓ No pre-socking of catalyst necessary,
 - ✓ No vibration of the tube necessary,
 - ✓ 4" @ 10 meter height tube in approx. 10 min.

 UNIDENSE® Technology

- In 2009, UNIDENSE® Technology GmbH introduces the UNILOADER®



- Innovative features:
 - Rope is pulled up automatically,
 - Catalyst is delivered into the tube by conveyor belt.
- Rope and conveyor speeds can be regulated to achieve desired density
- Constant dust removal

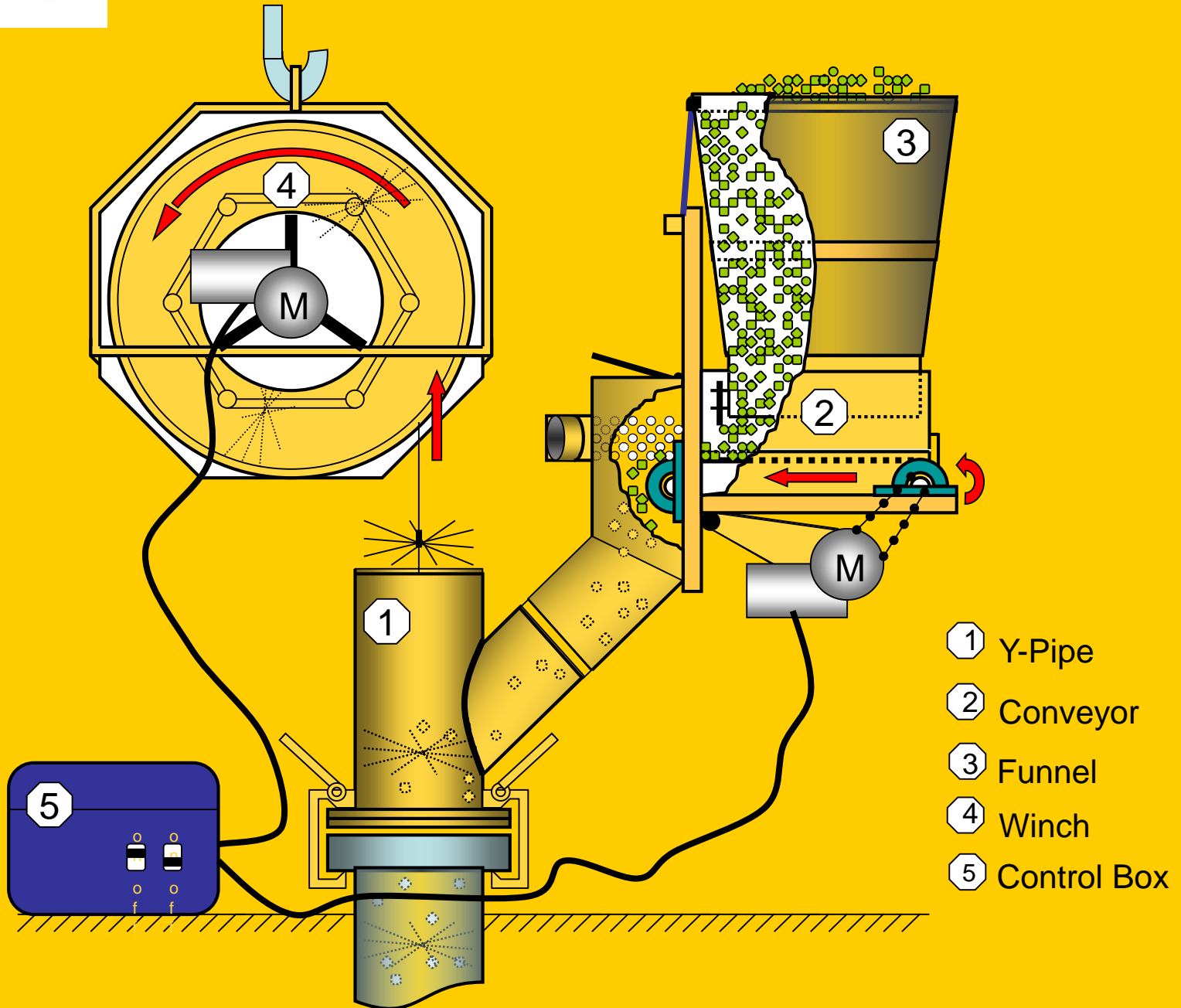
The UNILOADER® brings new benefits to the UNIDENSE® technology. The possibility for human error is eliminated by the UNILOADER®, and it works more accurately. This results in a better density and improves the average pressure drop to less than $\pm 3\%$. This improved performance is achieved by faster loading against the manual technique. The dust removal system ensures healthier working conditions and less contamination of the tubes.

 UNIDENSE® Technology

What is the UNILOADER®?

- ❑ An automated tube loading machine
- ❑ Able to replace additional manpower
- ❑ Able to give the best available quality
- ❑ A big step forward in reformer catalyst loading
- ❑ Supported and recommended by most catalyst suppliers





COMPARISON

Conventional UNIDENSE® vs. UNILOADER®

Conventional
UNIDENSE®



Two technicians required to operate the rope and loading funnel

dP Guarantee +/- 5%

Batch loading as the activity pauses when changing buckets

Dust removal passively

High human error possibility

UNILOADER®



Only one worker is required to operate the UNILOADER®

dP Guarantee +/- 3%

Continuous catalyst loading

Active de-dusting capability

Eliminates human error



Catalyst Loading Rate Table

No of Tubes	UNILOADER®	Workers*	Shifts
<100	1	4	1-2
<200	2	6	2
<300	2	8	2-3
<400	3	8	3
<500	3	8	4
<600	4	12	4
<700	4	12	4-5
<800	4	12	5
<900	5	14	6

* + One Unidense® Supervisor per shift + single layer catalyst

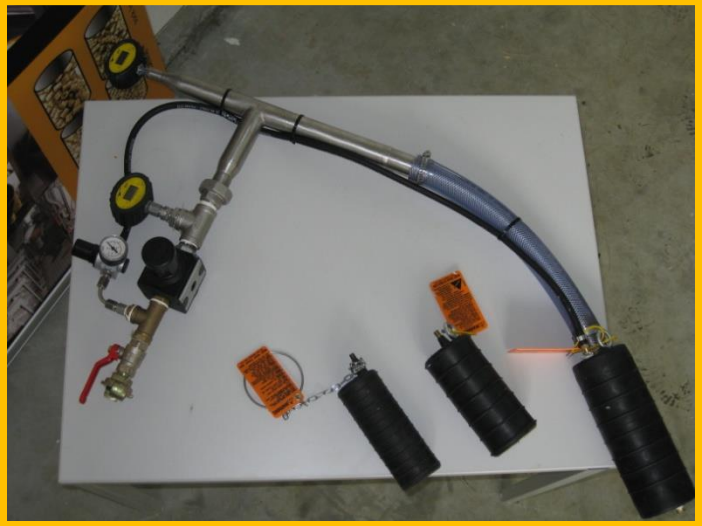


UNIDENSE® Technology

RANGE OF SERVICES

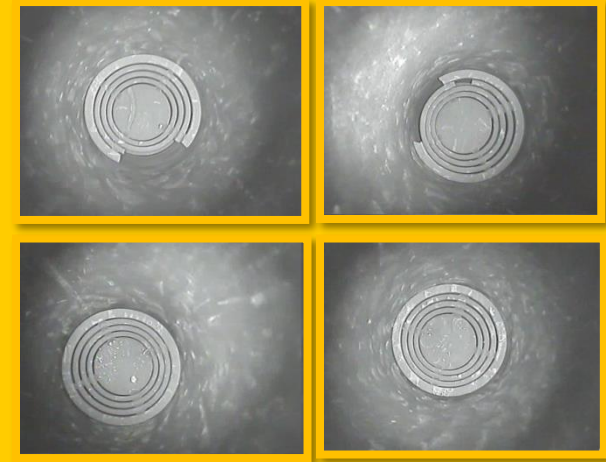
- UNIDENSE® / UNILOADER®
- VIDEO INSPECTION
- DP EQUIPMENT

DP EQUIPMENT



- ✓ Accurate, fast, consistent & reliable

VIDEO INSPECTION



- ✓ Takes 2 minutes per tube
- ✓ Allows to identify contamination / impurities and/or damages





Innovation through Continuous Research & Development

INTUBE CLEANER

- ❑ Technology advancement in internal tube cleaning
- ❑ Available in pneumatic driven and electrical motor driven brush system
- ❑ 360° cleaning effect





UNIDENSE® Technology

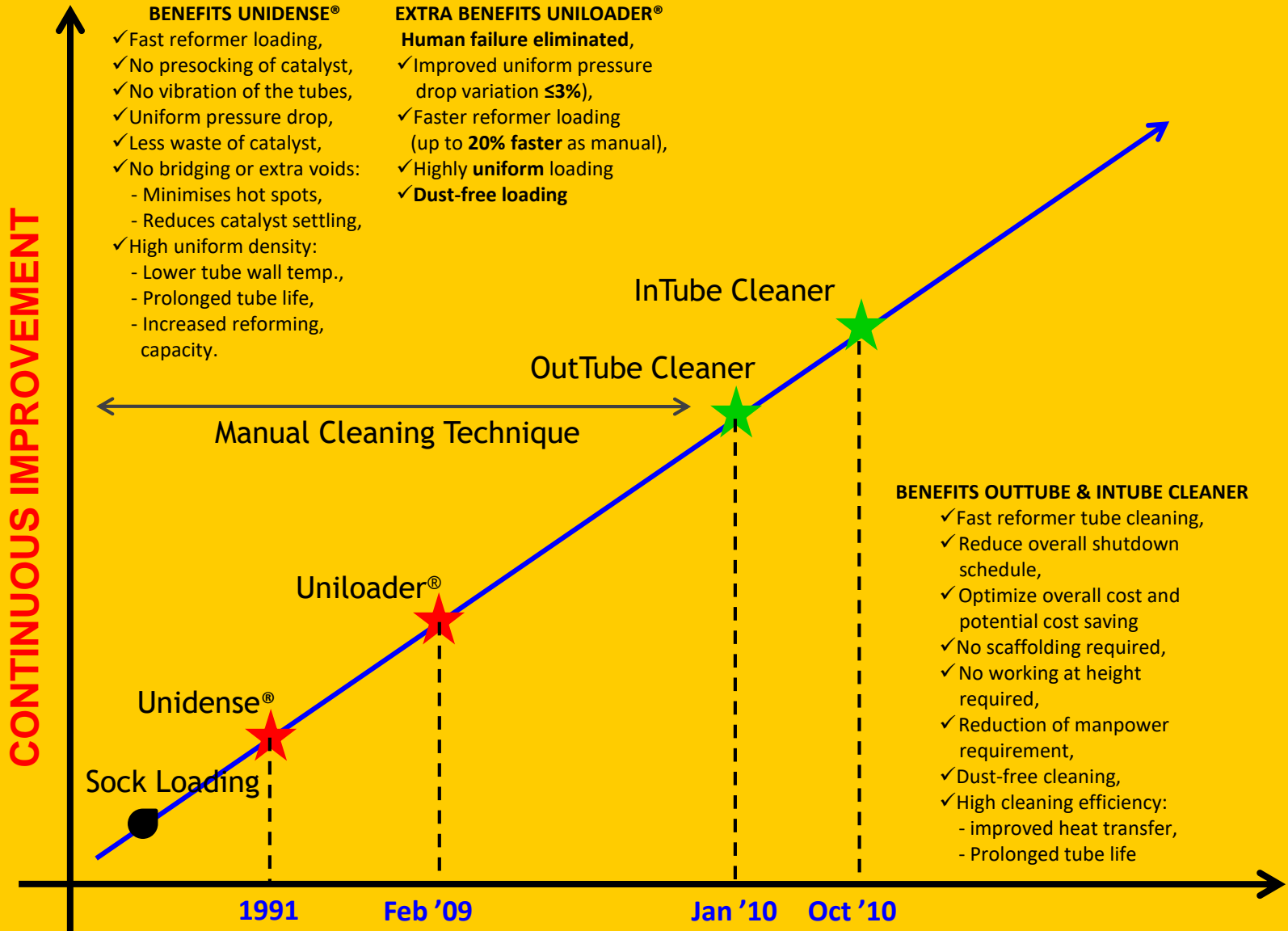
Innovation through Continuous Research & Development

OUTTUBE CLEANER

- Technology advancement in external tube cleaning
- Electrical motor (24V) driven brush system
- 360° cleaning effect
- No scaffolding required in confined space
- No working at height in confined space
- Reduction of manpower



SUMMARY OF TECHNOLOGY ADVANCEMENT





THANK YOU

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