TECHNOLOGY ADVANCEMENT IN CATALYST LOADING AND TUBE CLEANING FOR REFORMERS

UNIDENSE® Technology GmbH
Alexander-von-Humboldt Straße 2
01987 Schwarzheide
GERMANY

www.unidense.com
your reformer technology services provider of choice
UNIDENSE® Technology GmbH

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 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-scocking 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 ± 5% (±3% = realistic).

![Sock Loading Method 100 mm tube](image1)

![UNIDENSE® Method 100 mm tube](image2)
• 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.
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 ±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.
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
1 Y-Pipe
2 Conveyor
3 Funnel
4 Winch
5 Control Box
## COMPARISON

### Conventional UNIDENSE® vs. UNILOADER®

<table>
<thead>
<tr>
<th>Conventional UNIDENSE®</th>
<th>UNILOADER®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two technicians required to operate the rope and loading funnel</td>
<td>Only one worker is required to operate the UNILOADER®</td>
</tr>
<tr>
<td>dP Guarantee +/- 5%</td>
<td>dP Guarantee +/- 3%</td>
</tr>
<tr>
<td>Batch loading as the activity pauses when changing buckets</td>
<td>Continuous catalyst loading</td>
</tr>
<tr>
<td>Dust removal passively</td>
<td>Active de-dusting capability</td>
</tr>
<tr>
<td>High human error possibility</td>
<td>Eliminates human error</td>
</tr>
</tbody>
</table>
## Catalyst Loading Rate Table

<table>
<thead>
<tr>
<th>No of Tubes</th>
<th>UNILOADER®</th>
<th>Workers*</th>
<th>Shifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>1</td>
<td>4</td>
<td>1-2</td>
</tr>
<tr>
<td>&lt;200</td>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>&lt;300</td>
<td>2</td>
<td>8</td>
<td>2-3</td>
</tr>
<tr>
<td>&lt;400</td>
<td>3</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>&lt;500</td>
<td>3</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>&lt;600</td>
<td>4</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>&lt;700</td>
<td>4</td>
<td>12</td>
<td>4-5</td>
</tr>
<tr>
<td>&lt;800</td>
<td>4</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>&lt;900</td>
<td>5</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

* + One Unidense® Supervisor per shift + single layer catalyst
RANGE OF SERVICES

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

DP EQUIPMENT

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

✓ Accurate, fast, consistent & reliable
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

CONTINUOUS IMPROVEMENT

BENEFITS UNIDENSE®
✓ Fast reformer loading,
✓ No presocking of catalyst,
✓ No vibration of the tubes,
✓ Uniform pressure drop,
✓ Less waste of catalyst,
✓ No bridging or extra voids:
  - Minimises hot spots,
  - Reduces catalyst settling,
✓ High uniform density:
  - Lower tube wall temp.,
  - Prolonged tube life,
  - Increased reforming capacity.

EXTRA BENEFITS UNILOADER®
Human failure eliminated,
✓ Improved uniform pressure drop variation ≤3%
✓ Faster reformer loading (up to 20% faster as manual),
✓ Highly uniform loading
✓ Dust-free loading

BENEFITS OUTTUBE & INTUBE CLEANER
✓ Fast reformer tube cleaning,
✓ Reduce overall shutdown schedule,
✓ Optimize overall cost and potential cost saving
✓ No scaffolding required,
✓ No working at height required,
✓ Reduction of manpower requirement,
✓ Dust-free cleaning,
✓ High cleaning efficiency:
  - Improved heat transfer,
  - Prolonged tube life

Manual Cleaning Technique

Unidense®
Sock Loading

Uniloader®

OutTube Cleaner

InTube Cleaner

1991 Feb '09 Jan '10 Oct '10
Thank you

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The responsibility for the content of the publication is the author.