interpack 2017

Optimized package sealing reduces food waste
Ultrasonic welding technology for packaging applications
Optimized package sealing reduces food waste

Agenda

1. Packaging and the food value chain
2. Packaging processes – Influences and conflicting goals
3. Ultrasonic welding technology for packaging – Fundamentals
4. Weld process parameters and weld process window
5. Ultrasonic welding technology for packaging – Success factors
6. Food waste saving potentials – Facts & figures
7. One glance ahead – Trends, requirements and approaches
Matching food packaging process requirements reduces waste

Why do we need packages?

- protecting food quality
  - nutritional values
  - taste, appearance, texture ...
  - hygiene
- storage, logistic and distribution
- retail
- information and advertisement

Food packaging processes have to ensure that food packages provide the highest possible quality for consumers.
Along the food value chain many individual factors are responsible for losses.
Smart and sustainable production and packaging concepts help to improve the supply of food to a growing global population.

Optimized packaging processes using high sophisticated technology are a key success factor.
Optimized package sealing reduces food waste

Packaging process: influences and conflicting goals

Influences
- packaging material quality
- product (to be packed) quality
- process liquids and gases
- machinery equipment
- operator skills
- environmental conditions

Cost reduction
- cheaper packaging materials
- increased OEE at higher line speed
- reduced efforts for manual inspection
- reduced reject rates
- resource-saving production
The question is:

Where can you
- collect data
- gather information
- monitoring processes

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The packaging process chain

- packaging materials
- packaging aids
- process media
- product
- packaging machinery
  - forming
  - transporting
  - dosing
  - closing
- secondary packaging process
- transport
  - logistic
  - retail
- consumption

possibilities for process monitoring
border of process steps to be monitored
The question is:

Where can you

- collect data
- gather information
- monitoring processes

Packaging processes need to be automated.

Relevant process parameters need to be identified and must be described by means.
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The packaging process chain

- transporting
- forming
- dosing

- sealing

- secondary packaging
- transporting
- logistic

either you check quality

or...

creating seal quality

creating quality

checking quality
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The packaging process chain

- transporting
- forming
- dosing

ultrasonic sealing

- secondary packaging
- transporting
- logistic

single point to receive data about sealing process quality

creating quality      checking quality

you create quality and monitor your processes
Ultrasonic welding uses mechanical sound waves (vibrations) to create frictional heat resulting in melt to create molecular bonding thru diffusion of molecules, entanglement of molecular chains and physical/chemical adhesion.

Frictional heat is a result of:

- **small deformation** at high speed = friction within molecular chains
- **interfacial friction** = friction between contact surfaces

During an ultrasonic welding process mechanical vibrations of an ultrasonic frequency $f$ with defined amplitude $a$, force $F$ and duration $t$ is applied.
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Fundamentals of ultrasonic welding technology

How does ultrasonic welding work?

Ultrasonic vibrations = mechanical vibrations

- Create deformation within the material (plastic)
- Create friction within the molecules chains
- Create friction between the contact areas
- Frictional heat creates melt
- Melt creates bonding within the molecular chains by diffusion and entanglement
- Heat is created only within material at the seam
- Contact surfaces of material and ultrasonic tool remain cold
- Ultrasonic tools remain cold
- Material melts down rapidly
- Melting and bonding at same time due to vibration

**Temperature Distribution**

![Temperature Distribution Diagram](image)

- **T [°C]**
- **T seam inside**
- **T film outside**

- **heat contact sealing**
- **ultrasonic sealing**

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Fundamentals of ultrasonic welding technology

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Weld process parameters and weld process window

- **Amplitude [µm]**
  - Setting [%] at generator
  - Ramp up of amplitude

- **Welding force [N]**
  - Packaging machinery equipment function
  - Springs, pneumatic cylinders, electrical drives
  - Preloaded pneumatic cylinder, controlled via. proportional valve at Herrmann Top Seal Module (TSM)

- **Programmed switch off criteria:**
  - TIME [ms]
  - ENERGY [J]
  - POWER [W]
  - DISTANCE [µm]
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$t_1 = t_2 = t_3$
$E_1 \neq E_2 \neq E_3$
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Optimized package sealing reduces food waste
Better solutions for challenges – Key success factors

- Tight sealing – despite of product in seal area
- Integrated process monitoring / Reduction of quality control costs
  - Detection of pouches not proper sealed
  - Weld process window – measured values per pouch
  - Detection of double pouch or missing pouch
- Reduced machine down time
  - No heat-up or cool-down required / immediate availability
  - Change of weld parameters on the fly with immediate response
- Gentle to product and packaging material
  - No burning of packages and material at machine stop
  - No film shrinkage
  - No thermal impact to product packed

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Optimized package sealing reduces food waste

Integrated process monitoring

Pouch present:
- Start ultrasonic welding process
- Assessment of measured values
- Evaluation GOOD / SUSPECT (TIME, ENERGY, POWER, DISTANCE)
Optimized package sealing reduces food waste
Integrated process monitoring

No pouch present:
- No start of ultrasonic welding process
- Avoids metal to metal contact of vibrating tools → protects tools for damage
Optimized package sealing reduces food waste

Integrated process monitoring

**Double pouch:**
- Optional start ultrasonic welding process
- Rejection of pouch
Optimized package sealing reduces food waste

Integrated process monitoring

Big wrinkle in pouch:
→ Optional start ultrasonic welding process
→ Rejection of pouch
Optimized package sealing reduces food waste
Integrated process monitoring

Small wrinkle – not detected:
→ Start ultrasonic welding process → Assessment of measured values → Evaluation GOOD / SUSPECT (TIME, ENERGY, POWER, DISTANCE)
→ Tight seam possible
Optimized package sealing reduces food waste
Better solutions for challenges – Key success factors

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Ultrasonic welding is welding with cold tools

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Weld process window - Example

- wide and comfortable weld process window
- quality request for retort able SUP = weld seam strength > 40N/15mm
  ➔ minimum weld force of 5N/mm is required
  ➔ minimum energy > 30J is required
  ➔ weld force can vary from 5N/mm to 7N/mm
  ➔ weld time can vary from 150ms to 225ms
Optimized package sealing reduces food waste
Benefits for End Users

Package to ship - facts and figures: SUP top seam

Causes for leakers

- contaminated seal area
- wrinkles due to insufficient transportation and clamping
- shrunken seams by overheated films
- steam injection → condensed water drops out
- pouch not aligned in right position
- double pouch in sealing station
Optimized package sealing reduces food waste
Food waste saving potential

Package to ship - facts and figures:  
SUP top seam

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<th>ultrasonic seal</th>
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<tr>
<td>number of machines</td>
<td>35</td>
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<td>strokes per minute</td>
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<td>number of sealing stations</td>
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<td>pouches per shift (7)</td>
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<td>3.645.600</td>
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<tr>
<td>pouches per day (3 shifts, 21h)</td>
<td>10.936.800</td>
<td>10.936.800</td>
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<tr>
<td>percentage of leaking pouches</td>
<td>0.050%</td>
<td>0.002%</td>
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<tr>
<td>regular / simple products</td>
<td>5 out of 10.000</td>
<td>0.2 out of 10.000</td>
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<tr>
<td>leaking pouches per day</td>
<td>5.468</td>
<td>219</td>
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## Optimized package sealing reduces food waste

### Food waste saving potential

### Package to ship - facts and figures: SUP top seam

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<tr>
<td>Percentage of leaking pouches</td>
<td>0.200%</td>
<td>0.002%</td>
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**Graph:**
- **Pouches per day (3 shifts, 21h):**
  - Heat seal: 10,936,800
  - Ultrasonic seal: 10,936,800
- **Leaking pouches per day:**
  - Heat seal: 21,874
  - Ultrasonic seal: 219

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<tr>
<td>Critical products incl. fibres</td>
<td>20 out of 10,000</td>
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<tr>
<td>Leaking pouches per day</td>
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Optimized package sealing reduces food waste
Food waste saving potential

Package to ship - facts and figures: VFFS – cross seams for salad

Demand for ultrasonic sealed seams

- improved seal quality
- higher output

Results with ultrasonic sealing

- output 50 to 70 bag/min., depending on dosing system and type of salad
- salad leaves in seal area are not critical → ultrasonic seals thru product
- Rejects < 1% (typically < 0.5%)
- improved seal strength especially for orientated BOPP as ultrasonic not only seals the 2.5µm sealant
Optimized package sealing reduces food waste
Food waste saving potential

Package to ship - facts and figures: VFFS – cross seams for salad

heat seal:
- 45 bags/minute
- 5% rejects

ultrasonic seal:
- 65 bags/minute
- 0.5% rejects
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One glance ahead – Trends, requirements and approaches

- Food packaging in flexible is further growing
- Cost pressure is increasing
- Processes need to be safe, reliable and ready for automatization
- Requirements regarding flexibility and self optimization increase → Packaging-Industry 4.0

Ultrasonic welding systems with digital ultrasonic generators in combination with internal measured values and external sensors enable intelligent and self-optimizing weld processes
Variety in film materials is expanding: Foil based → metallized → Paper-Laminate → „Mono“ → ....

One thing, though, is for sure – Ultrasonic creates heat directly within the sealing layer – independent of material composition

Optimized package sealing reduces food waste
One glance ahead – Trends, requirements and approaches
Variety in film materials is expanding: Foil based → metallized → Paper-Laminate → „Mono“ → ....

One thing, though, is for sure – Ultrasonic creates heat directly within the sealing layer – independent of material composition.
Optimized package sealing reduces food waste

One glance ahead – Trends, requirements and approaches

Continuously or intermittent?
- Market is demanding for continuous operating packaging lines for large product volumes

Are there ultrasonic systems for continuous weld processes?
YES
- Rotating sonotrodes vs. rotating anvil wheels
- Standard, longitudinal vibrating sonotrodes vs. anvil wheels or anvil knifes

Process monitoring?
Of course! For each single package.
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Around the world, ultrasonic welding technology for SUP

…more than 1300 installed sealing stations for SUP- top seam on more than 215 machines worldwide.
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ULTRASONIC SEALING
SAVES FOOD
Optimized package sealing reduces food waste
Meet with the ultrasonic experts – hall 11 booth D59
Optimized package sealing reduces food waste
Cutting edge technology worldwide

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