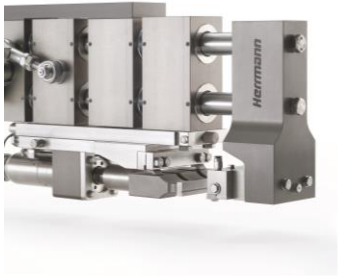
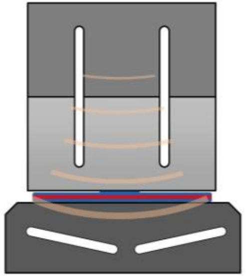
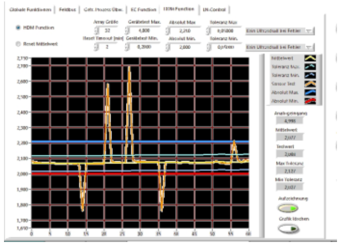






interpack 2017

Optimized package sealing reduces food waste

Ultrasonic welding technology for packaging applications

Optimized package sealing reduces food waste
Agenda

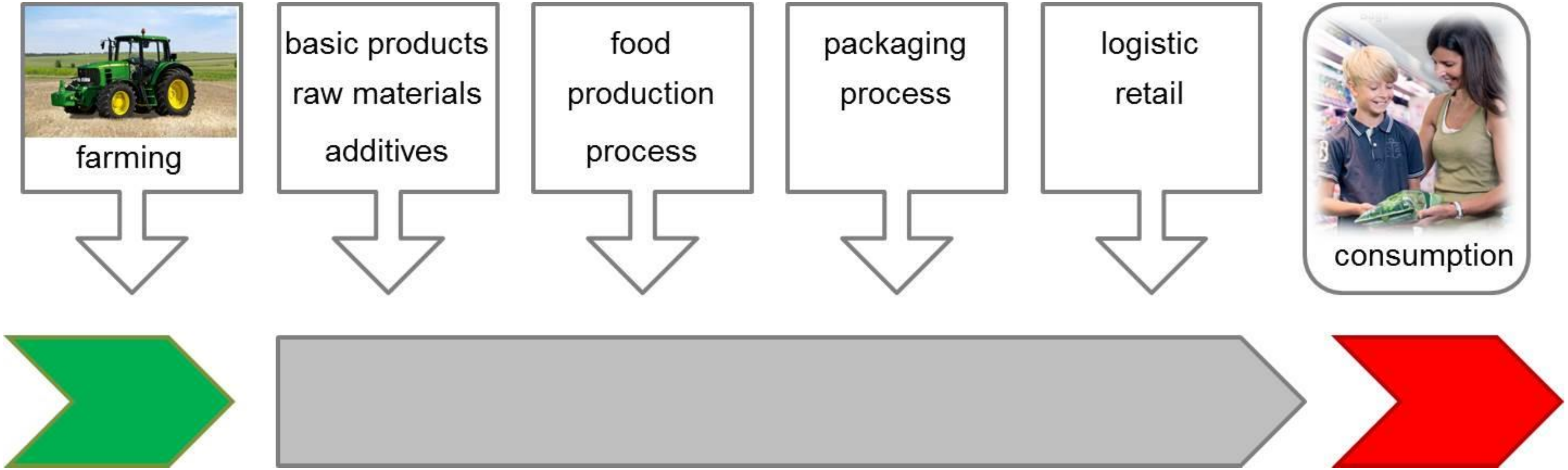
Matching food packaging process requirements reduces waste

Why do we need packages?

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

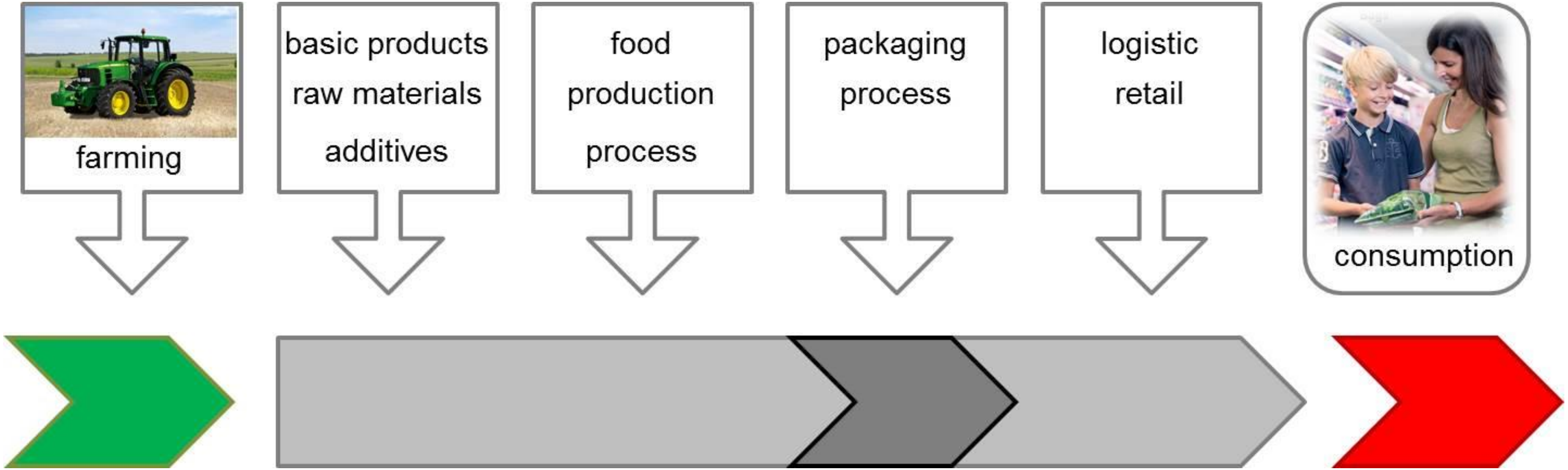
Food packaging processes have to ensure that food packages provide the highest possible quality for consumers.

Optimized package sealing reduces food waste
The food value chain



- Along the food value chain many individual factors are responsible for losses.

Optimized package sealing reduces food waste
The food value chain

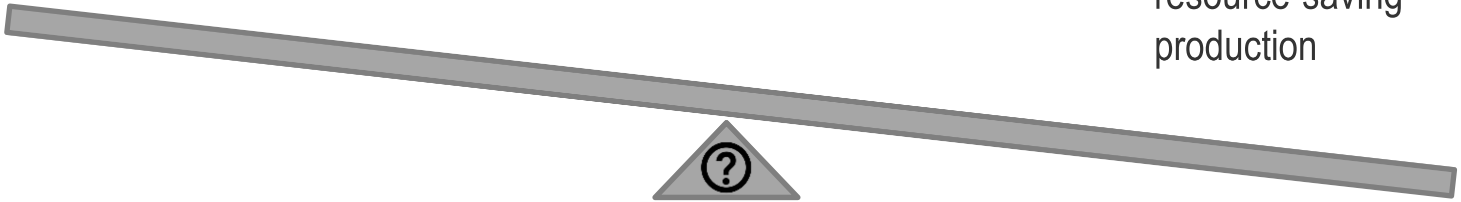


- Smart and sustainable production and packaging concepts help to improve the supply of food to a growing global population.
- **Optimized packaging processes using high sophisticated technology are a key success factor.**

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

Optimized package sealing reduces food waste
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

Optimized package sealing reduces food waste
The packaging process chain

- packaging materials
- packaging aids
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consumption

possibilities for process monitoring

border of process steps to be monitored

The question is:

Where can you

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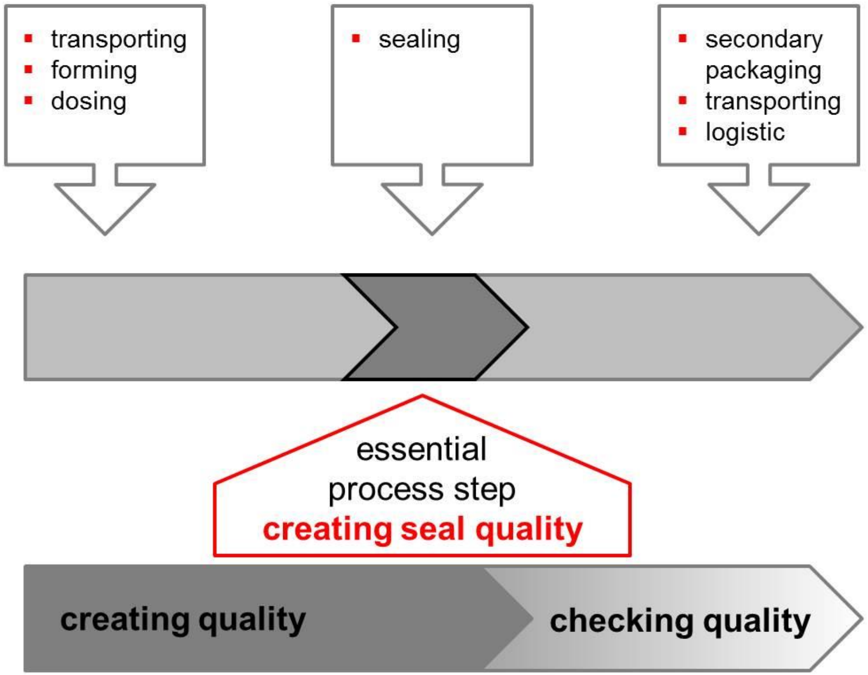
Packaging processes need to be automated.

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

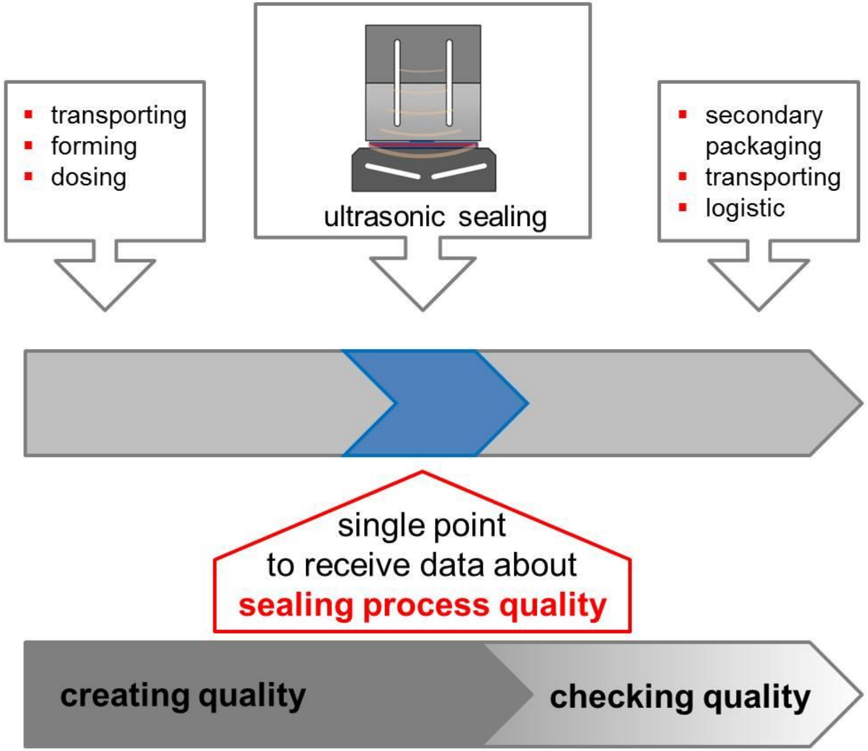
Optimized package sealing reduces food waste
The packaging process chain



either you check quality

or...

Optimized package sealing reduces food waste
The packaging process chain



you create quality and monitor your processes

Optimized package sealing reduces food waste
Fundamentals of ultrasonic welding technology

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

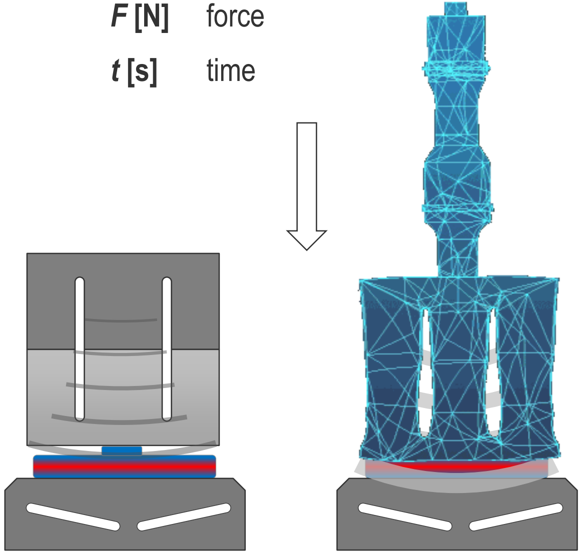
During an ultrasonic welding process mechanical vibrations of an ultrasonic frequency ***f*** with defined amplitude ***a***, force ***F*** and duration ***t*** is applied..

f **[Hz]** frequency

a **[µm]** amplitude

F **[N]** force

t **[s]** time

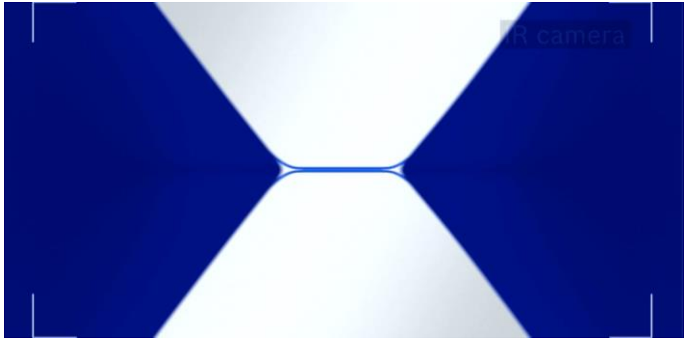


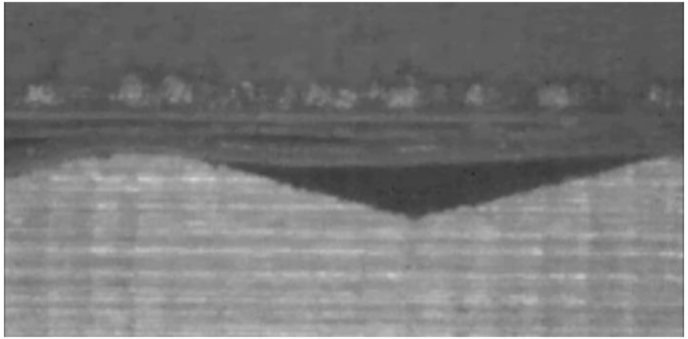
Optimized package sealing reduces food waste
Fundamentals of ultrasonic welding technology

How does ultrasonic welding work?

Ultrasonic vibrations = mechanical vibrations

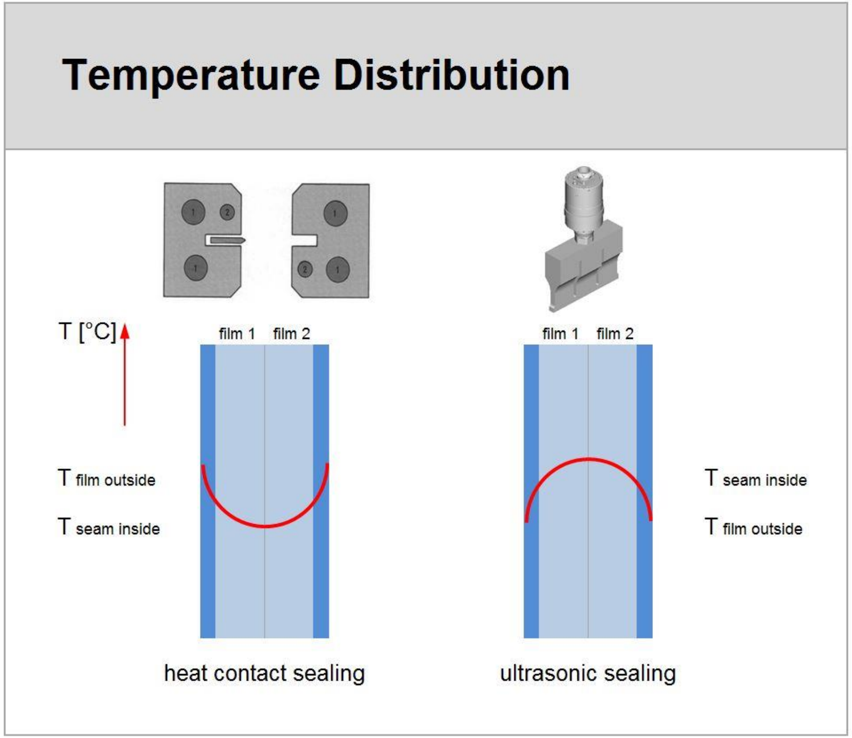
- Create deformation within the material (plastic)
- Create friction within the molecules chains
- Create friction between the contact areas
- Frictional heat creates melt
- Melt creates bonding within the molecular chains by diffusion and entanglement





Optimized package sealing reduces food waste
Fundamentals of ultrasonic welding technology

- 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



Optimized package sealing reduces food waste
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]

		ultrasonic welding process parameter					
switch off criteria		AMPLITUDE [µm / / %]	TIME [ms]	ENERGY [J]	POWER PEAK [W]	POWER Ø [W]	Distance relativ [µm]
	TIME	programmed value	programmed value	limit MIN limit MAX	limit MIN limit MAX	limit MIN limit MAX	limit MIN limit MAX
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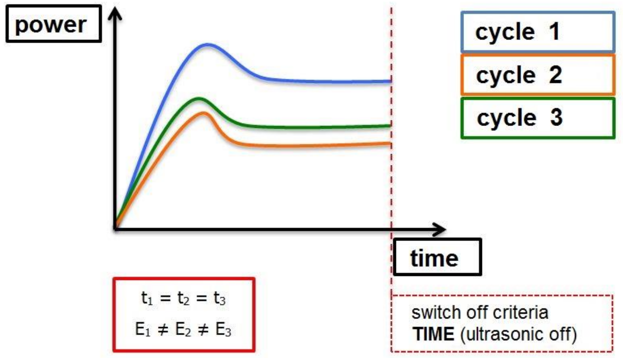

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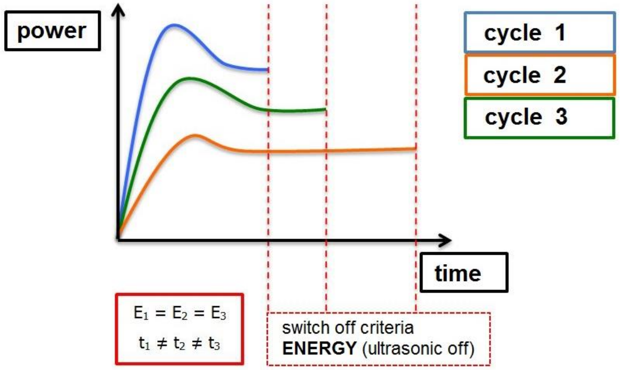

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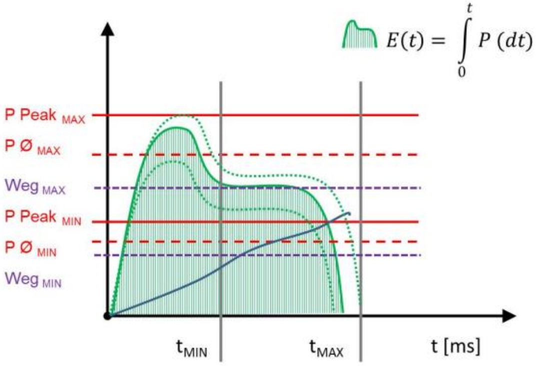

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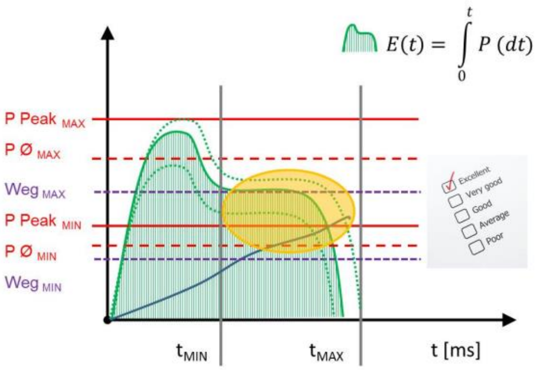

Optimized package sealing reduces food waste
Better solutions for challenges – Key success factors

- 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

switch off criteria		ultrasonic welding	
		AMPLITUDE [µm / / %]	TIME [ms]
	TIME	programmed value	programme value
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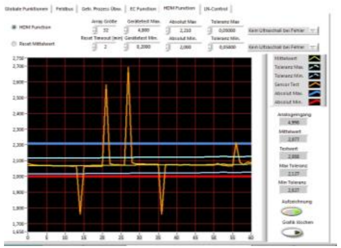

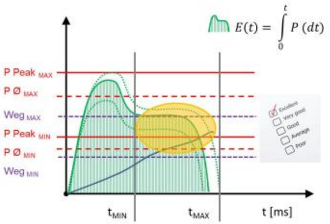

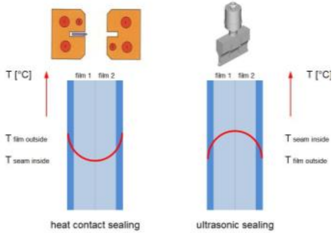

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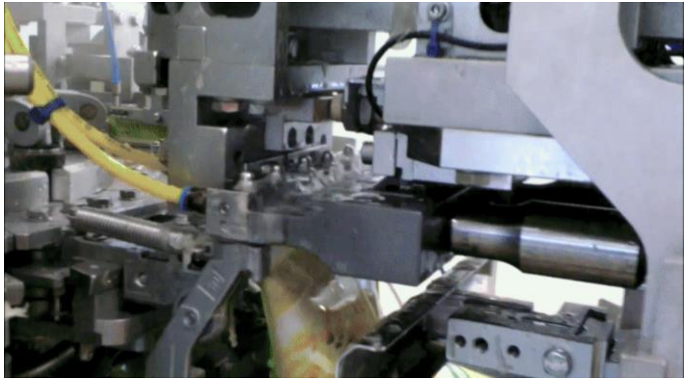

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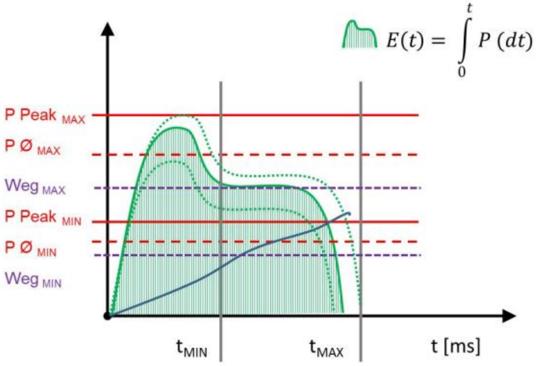

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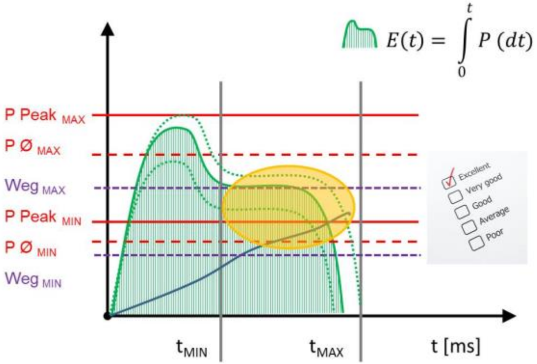

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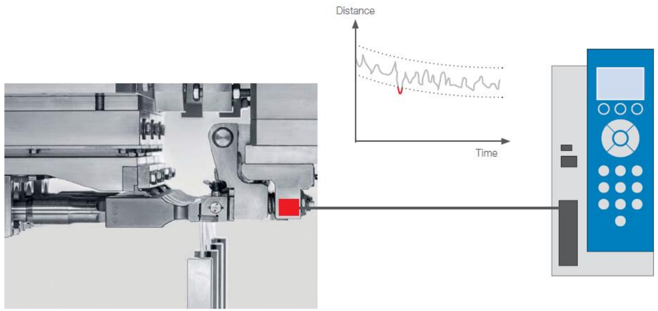
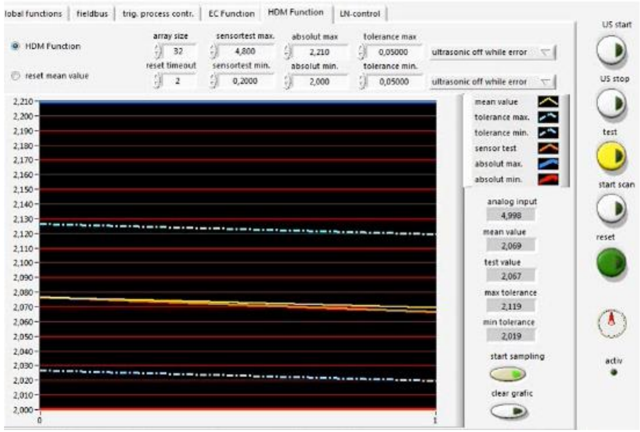
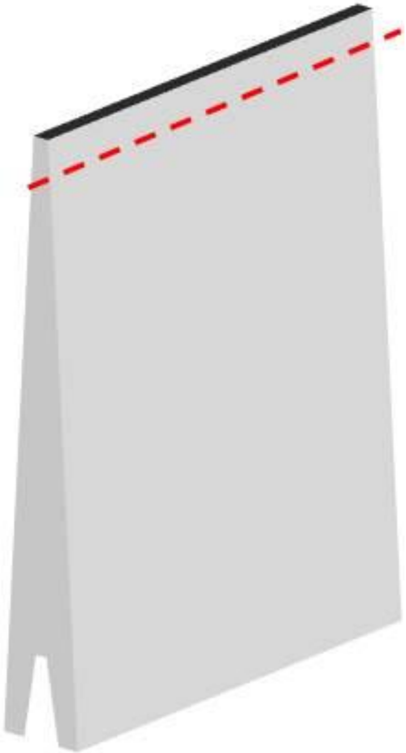
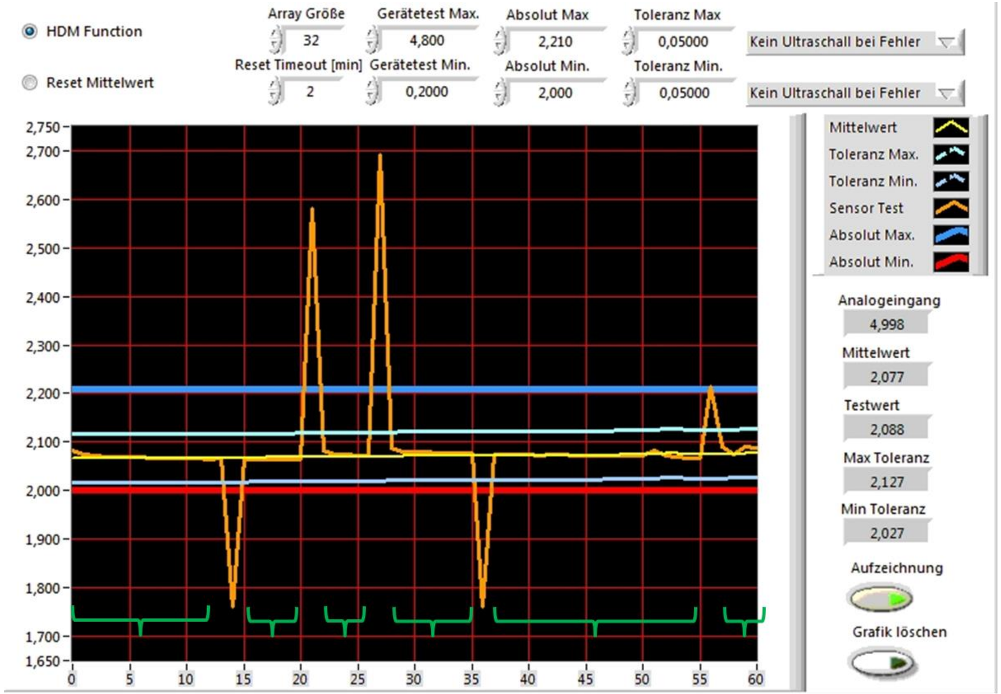




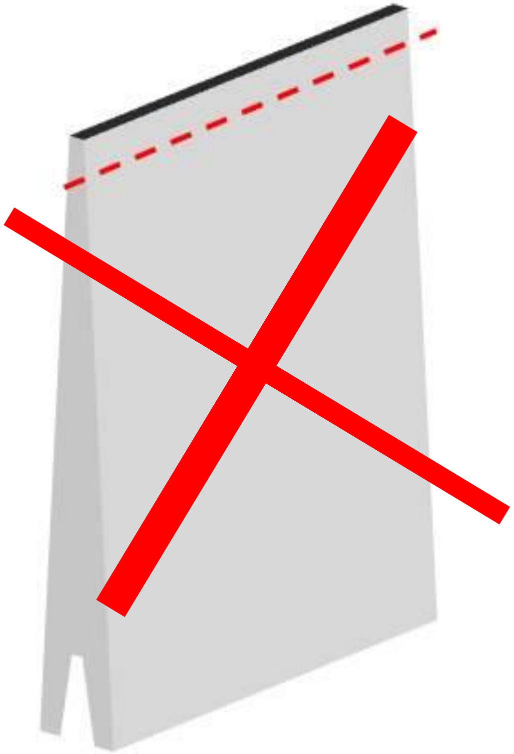
Optimized package sealing reduces food waste
Integrated process monitoring

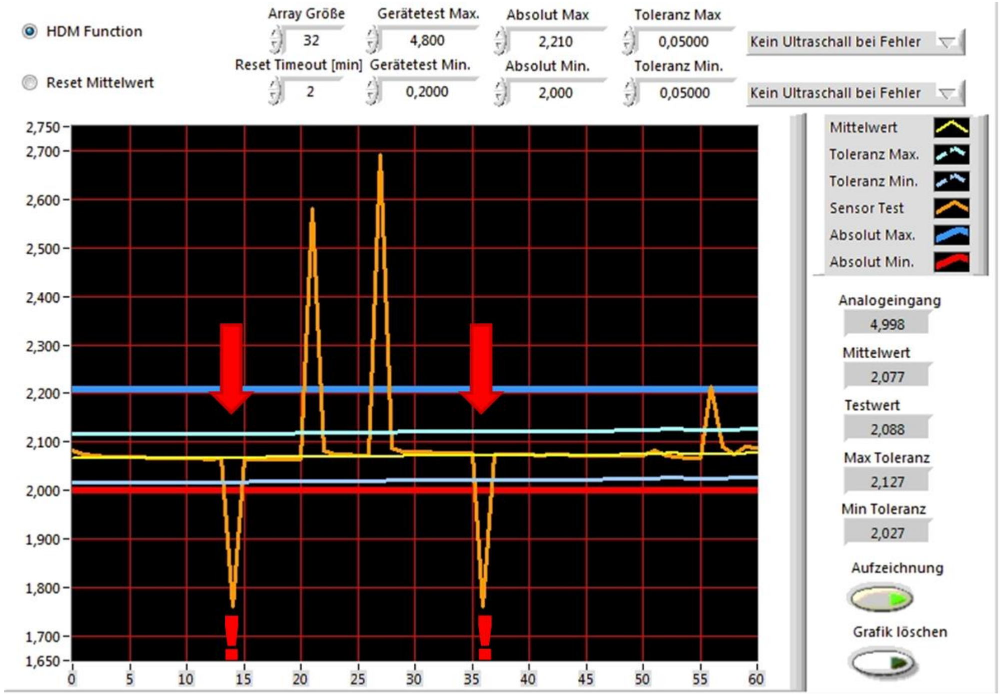




Pouch present:
→ Start ultrasonic welding process
→ Assesment of measured values→ Evaluation GOOD / SUSPECT (TIME, ENERGY, POWER, DISTANCE)

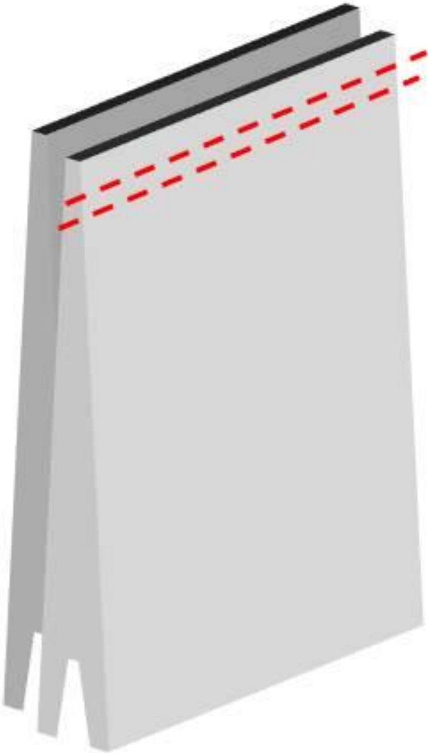
Optimized package sealing reduces food waste
Integrated process monitoring

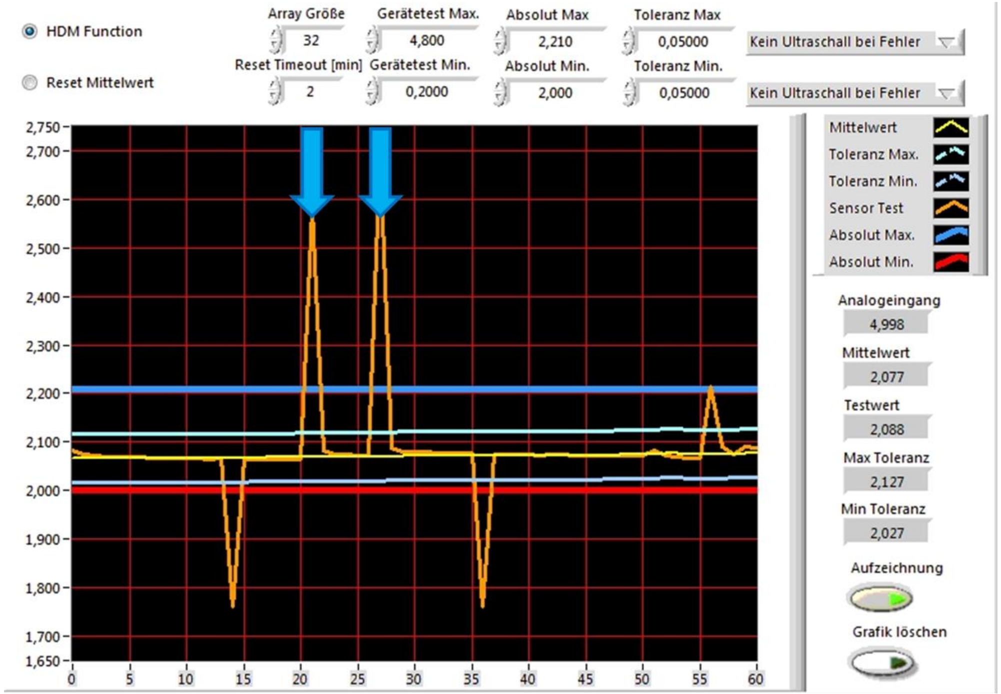




No pouch present:
→ No start of ultrasonic welding process
→ Avoids metal to metal contact of vibrating tools → protects tools for damage

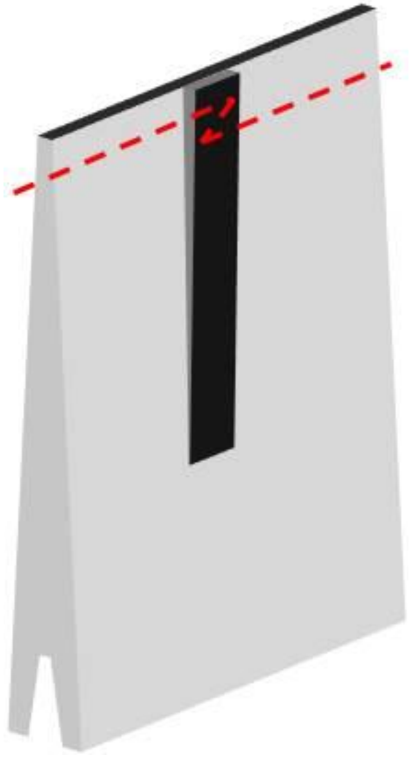
Optimized package sealing reduces food waste
Integrated process monitoring

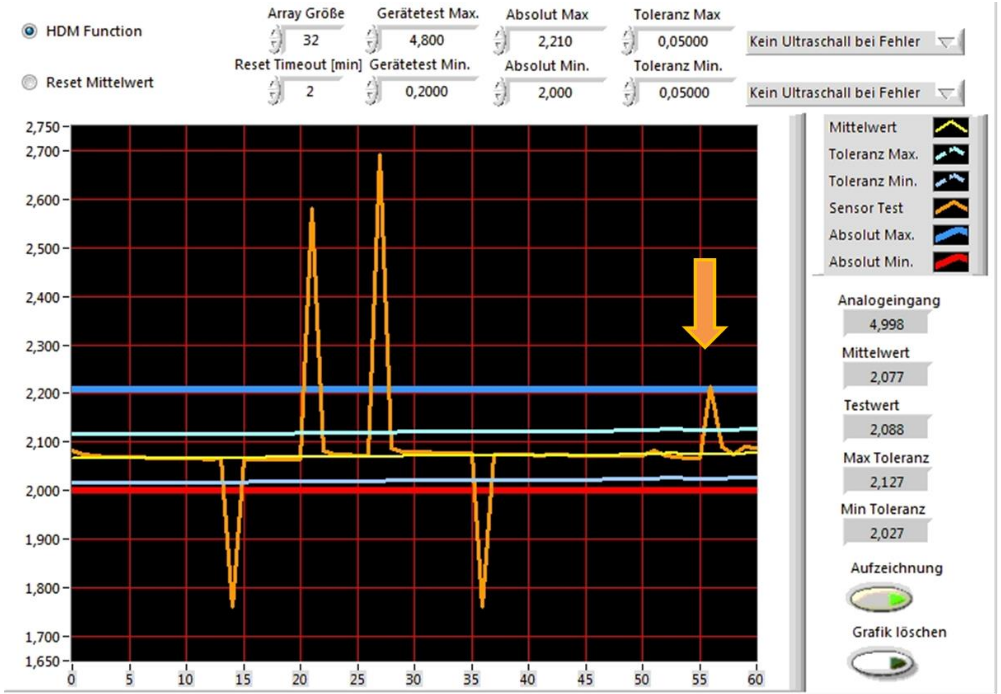




Double pouch:
→ Optional start ultrasonic welding process
→ Rejection of pouch

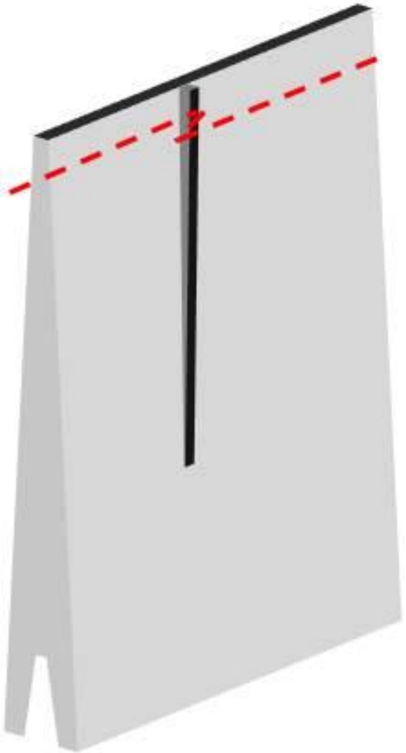
Optimized package sealing reduces food waste
Integrated process monitoring

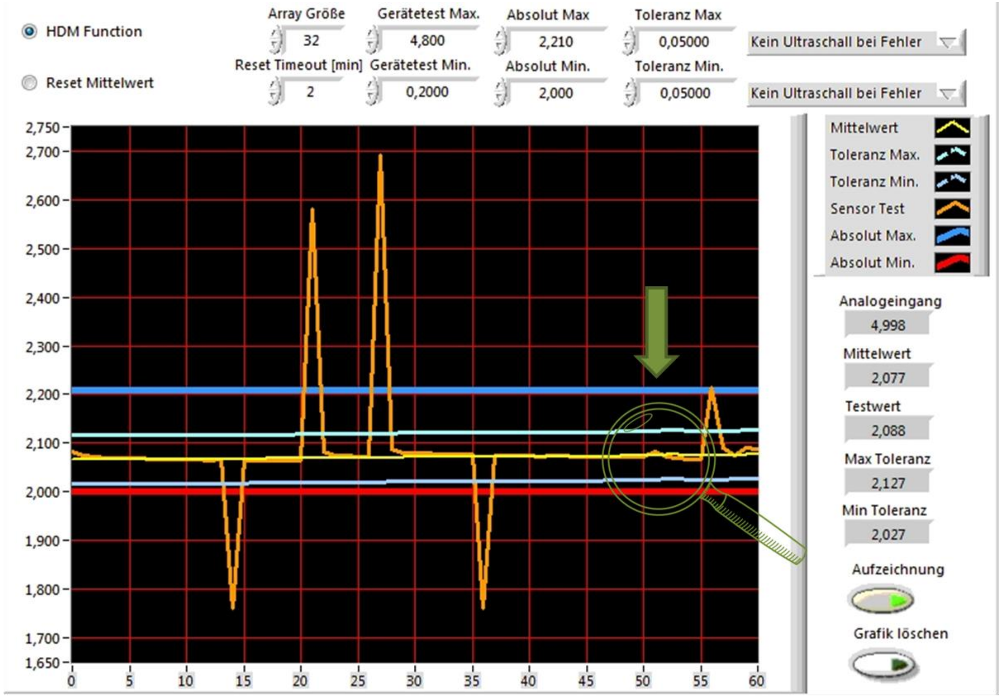




Big wrinkle in pouch:
→ Optional start ultrasonic welding process
→ Rejection of pouch

Optimized package sealing reduces food waste
Integrated process monitoring





Small wrinkle – not detected:
→ Start ultrasonic welding process → Assesment 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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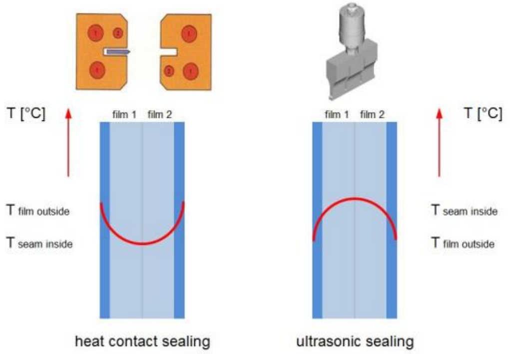
  - Detection of pouches not proper sealed
  - Weld process window – measured values per pouch
  - Detection of double pouch or missing pouch
- Reduced machine down time
  - No heat-up or cool-down required / immediate availability
  - Change of weld parameters on the fly with immediate response
- Gentle to product and packaging material
  - No burning of packages and material at machine stop
  - No film shrinkage
  - No thermal impact to product packed

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



Optimized package sealing reduces food waste

Weld process window - Example

Weld Process Window SUP Top Seal PET/AL/PP (12/8/65), Seam Length 95mm, 35kHz

Weld Force													
700N	seam strength [N/15mm]	31,8	47,7	48,7	49,4	46,8	50,2	51,2	49,3	50,8	51,5	46,9	44,5
	E [J]	22	30	37	41	27	37	46	57	31	42	54	66
	P max [W]	261	291	301	311	379	402	381	426	480	479	473	449
600N	seam strength [N/15mm]	28,3	39,8	47,2	49,6	46,9	51	52,6	50,7	47,7	51,3	52,3	52,3
	E [J]	20	26	32	39	28	39	47	55	32	43	53	62
	P max [W]	219	236	253	262	375	380	385	378	455	457	454	450
500N	seam strength [N/15mm]	5	13,3	31,5	41,6	35,7	38,6	45,3	51,1	35,3	42	51,1	53
	E [J]	16	20	25	30	20	25	33	39	21	29	38	47
	P max [W]	167	167	172	190	216	265	288	303	275	360	377	367
400N	seam strength [N/15mm]	0	0	0	0	0	8,2	8,4	16,2	3,3	14,5	35,7	38,3
	E [J]	0	0	0	0	0	16	20	24	14	18	23	28
	P max [W]	0	0	0	0	0	143	145	149	160	169	190	237
Weld Force	Weld Time	150ms	175ms	200ms	225ms	150ms	175ms	200ms	225ms	150ms	175ms	200ms	225ms
	Amplitude	12µ				15µ				18µ			

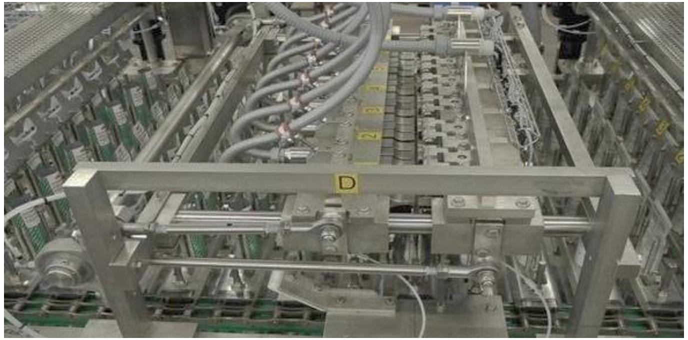
- wide and comfortable weld process window
- quality request for retort able SUP = weld seam strength > 40N/15mm
- ⇨ minimum weld force of 5N/mm is required
- ⇨ minimum energy > 30J is required
- ⇨ weld force can vary from 5N/mm to 7N /mm
- ⇨ weld time can vary from 150ms to 225ms

Optimized package sealing reduces food waste
Benefits for End Users

Package to ship - facts and figures: SUP top seam

Causes for leakers

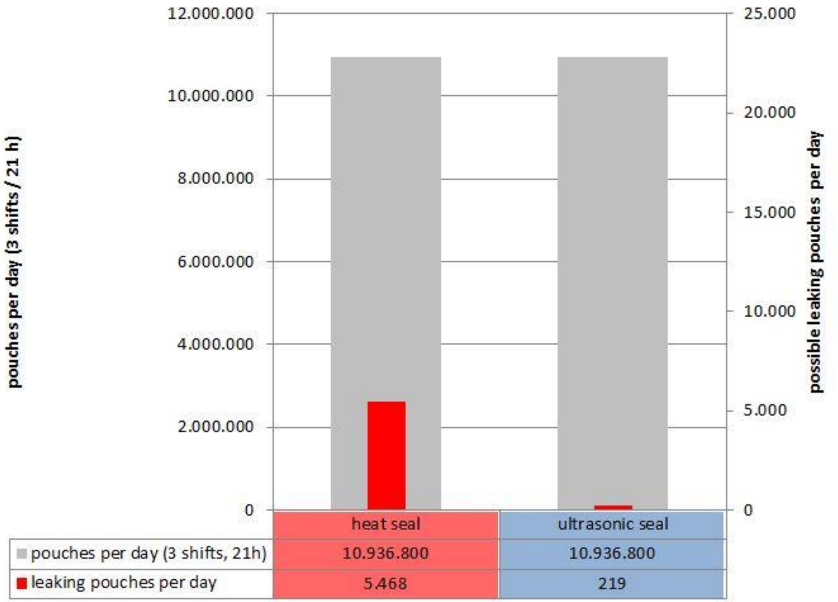
- contaminated seal area
- wrinkles due to insufficient transportation and clamping
- shrunken seams by overheated films
- steam injection → condensed water drops out
- pouch not aligned in right position
- double pouch in sealing station



Optimized package sealing reduces food waste
Food waste saving potential

Package to ship - facts and figures: SUP top seam

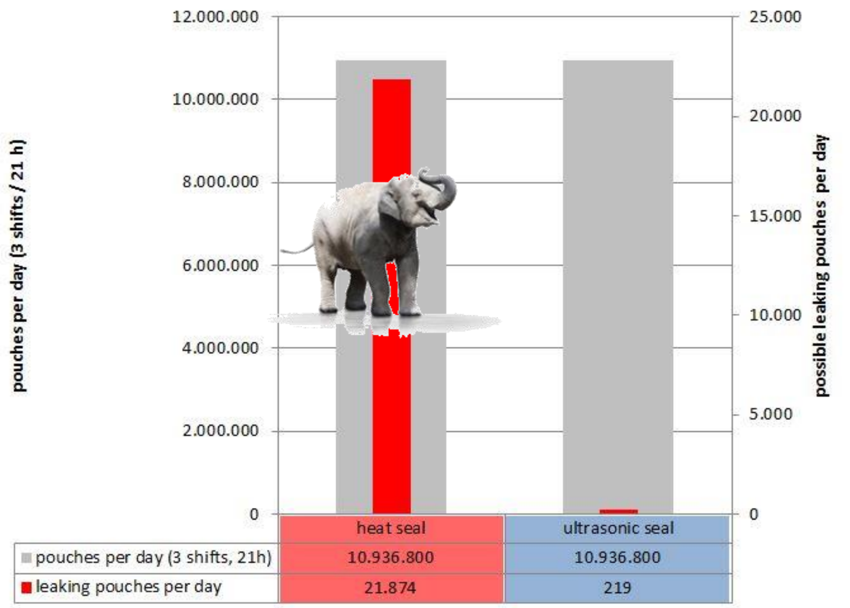
number of machines	35	
strokes per minute	62	
number of sealing stations	4	
pouches / minute	8.680	8.680
pouches per shift (7)	3.645.600	3.645.600
	heat seal	ultrasonic seal
pouches per day (3 shifts, 21h)	10.936.800	10.936.800
percentage of leaking pouches	0,050%	0,002%
regular / simple products	5 out of 10.000	0,2 out of 10.000
leaking pouches per day	**5.468**	**219**



Optimized package sealing reduces food waste
Food waste saving potential

Package to ship - facts and figures: SUP top seam

number of machines	35	
strokes per minute	62	
number of sealing stations	4	
pouches / minute	8.680	8.680
pouches per shift (7)	3.645.600	3.645.600
	heat seal	ultrasonic seal
pouches per day (3 shifts, 21h)	10.936.800	10.936.800
percentage of leaking pouches	0,200%	0,002%
critical products incl. fibres	20 out of 10.000	0,2 out of 10.000
leaking pouches per day	21.874	219



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

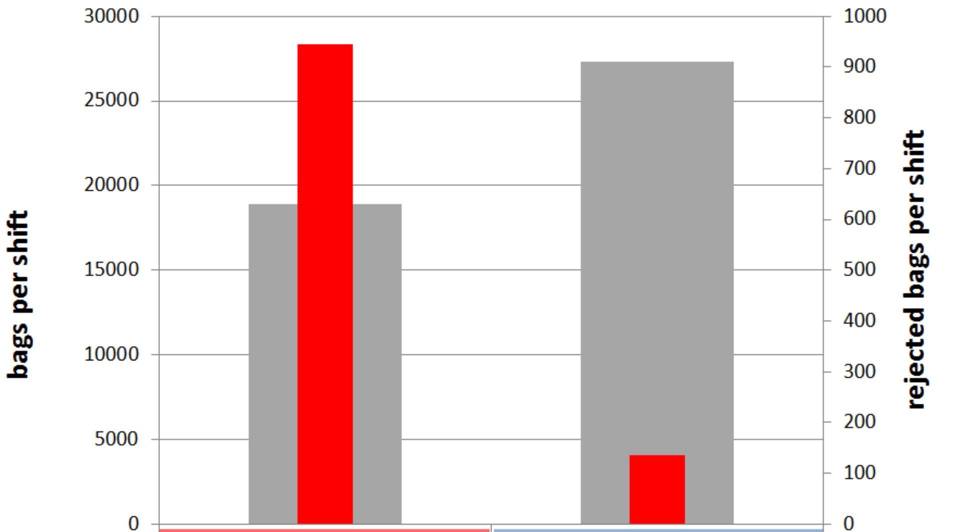
Results with ultrasonic sealing

- output 50 to 70 bag/min., depending on dosing system and type of salad
- salad leafs 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	ultrasonic seal
bags per shift (7h)	18900	27300
rejected bags	945	137

heat seal:

- 45 bags/minute
- 5% rejects

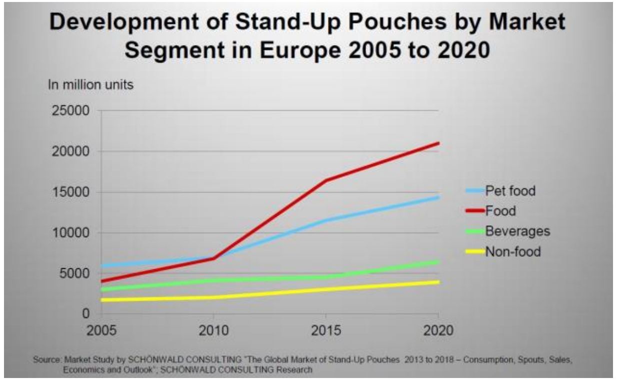
ultrasonic seal:

- 65 bags/minute
- 0,5% rejects

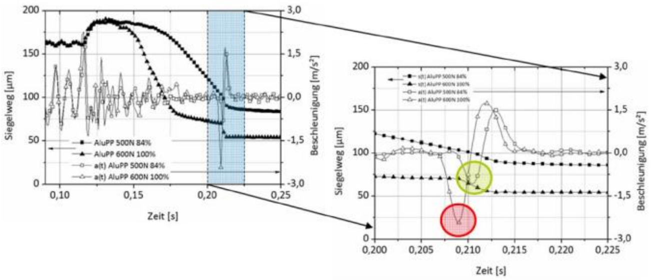
Optimized package sealing reduces food waste

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



Optimized package sealing reduces food waste

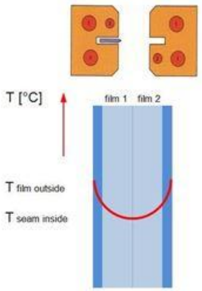
One glance ahead – Trends, requirements and approaches

Herrmann Ultraschall

- 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

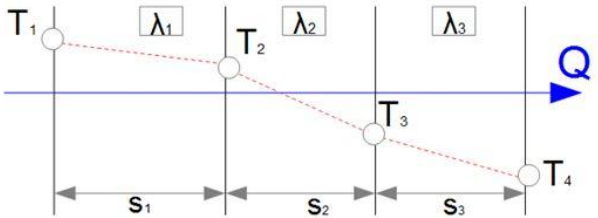
Optimized package sealing reduces food waste

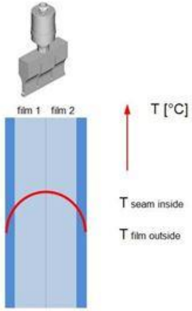
One glance ahead – Trends, requirements and approaches



heat contact sealing

Material	Heat conductivity λ [W/(m*K)
Paper	0,12
PET	0,24
PP	0,23
Alu	200 -- 230



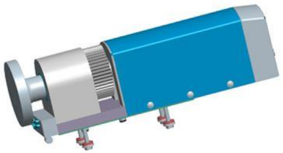


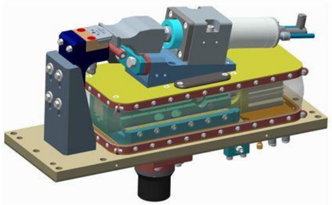
ultrasonic sealing

- 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

Continuously or intermittent?

- Market is demanding for continuous operating packaging lines for large product volumes





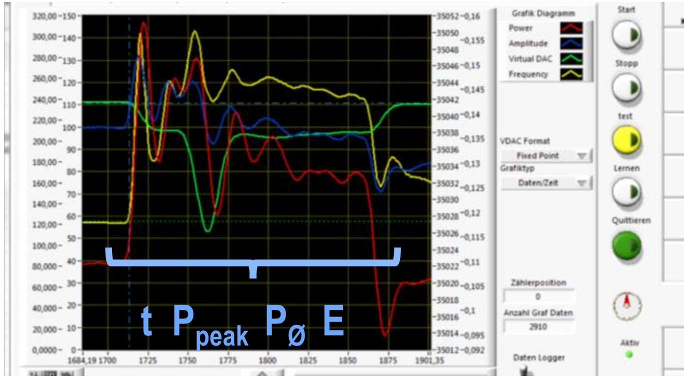
Are there ultrasonic systems for continuous weld processes?

YES

- Rotating sonotrodes vs. rotating anvil wheels
- Standard, longitudinal vibrating sonotrodes vs. anvil wheels or anvil knifes

Process monitoring?

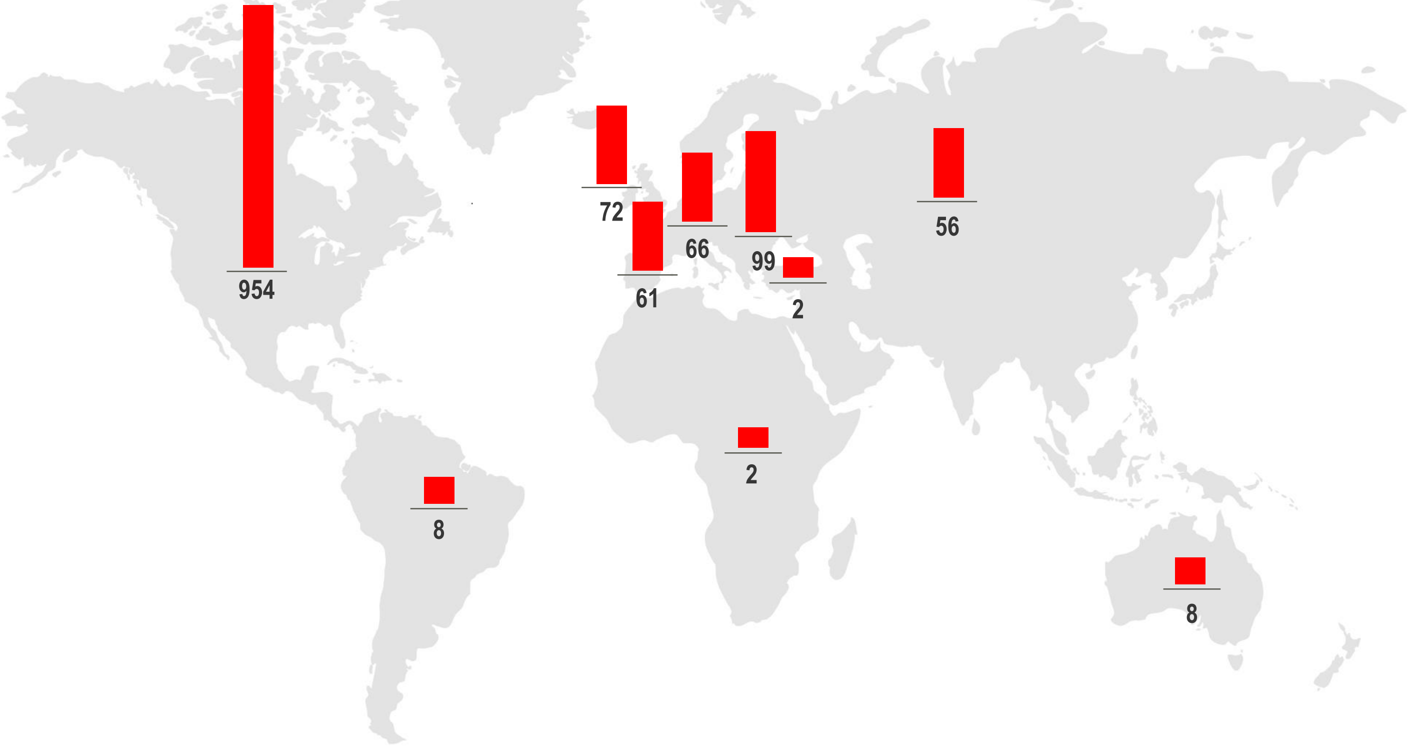
Of course! For each single package.



Optimized package sealing reduces food waste

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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Meet with the ultrasonic experts – hall 11 booth D59

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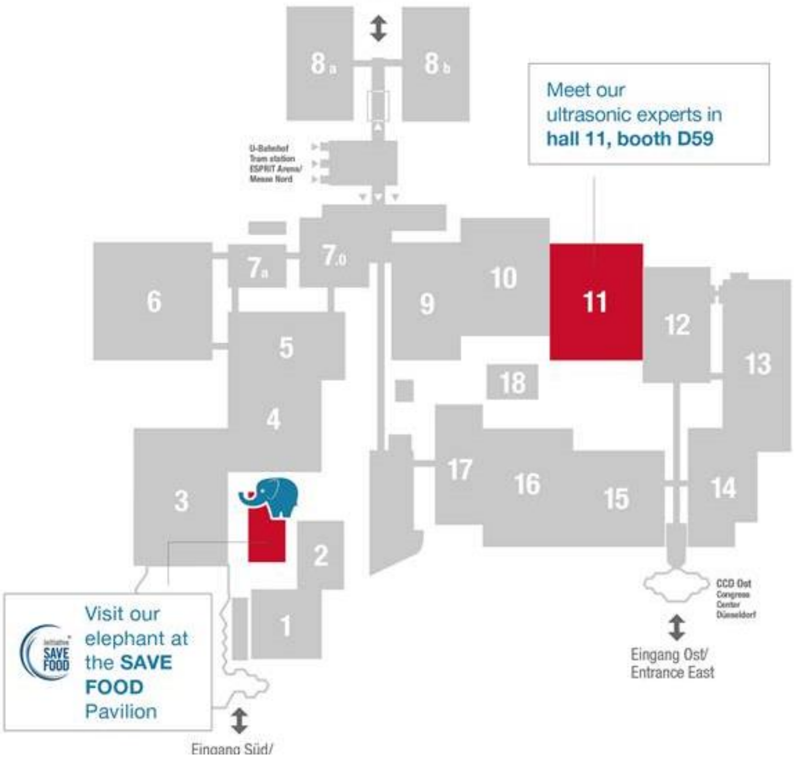

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Cutting edge technology worldwide

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