

“Pelletizing System Options for Extrusion”

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Types of Pelletizing Systems

- Strand – Water Bath
- Strand – Water Slide
- Hot Die Face – Air Cooled
- Die Face – Water Ring
- Die Face – Under Water
- Drop Pelletizing

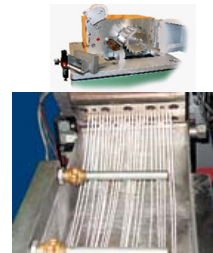
Strand – Water Bath - Strengths

- Low cost
- Simple to use
- Easy to clean and changeover



Strand – Water Bath - Weaknesses

- Very little automation
- Limited pellet size
- High cutter wear/maintenance
- Sensitive to process variations



Strand – Water Slide - Strengths

- Higher level of automation
- Self stranding
- Variable cooling
- Higher process rates
- More compact



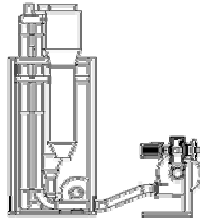
Strand – Water Slide - Weaknesses

- Higher cost
- High cutter wear and maintenance, but less than water bath
- Difficult to setup



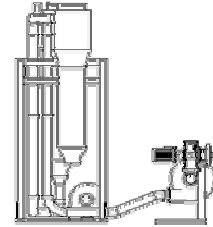
Hot Die Face – Air Cooled - *Strengths*

- Very simple design
- No contact with water
- Compact layout
- Easy to setup and operate



Hot Die Face – Air Cooled - *Weaknesses*

- Very limited cooling capability
- Low outputs
- High blade Wear
- High dust levels



Die Face – Water Ring - *Strengths*

- Relatively low cost
- Compact design
- Better cooling capabilities
- No die freezing



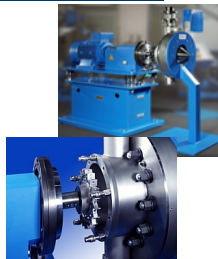
Die Face – Water Ring - *Weaknesses*

- Limited to Olefins
- Poor performance on high heat and sticky materials
- Limited application range



Die Face – Under Water - *Strengths*

- Highest automation
- Very versatile – can process most any polymer
- High blade life
- Production of micro pellets



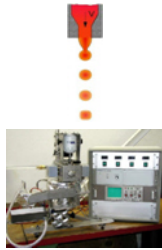
Die Face – Under Water - *Weaknesses*

- Relatively high system cost
- Complicated auxiliary and water/drying systems
- Die freeze issues on high heat products



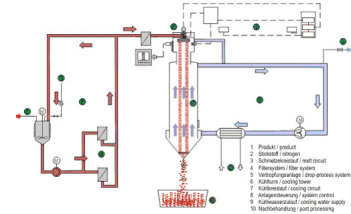
Drop Pelletizing - Strengths

- Specialty system for low viscosity polymers and waxes



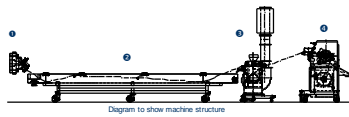
Drop Pelletizing - Weaknesses

- High cost and complexity



Strand Pelletizing, with manual feed

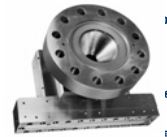
Normally, strand pelletizing with manual strand feed consists of the following components:
Strand Die ● Cooling trough ● Strand dryer ● Strand pelletizer ●



Extrusion Die

- Discharge angle between 45 & 90 degrees
- Die holes between 2 & 7 mm
- Maximum number of holes around 250
- Die width approximately 1500 mm
- Electric or oil heated

- Die body
- Flow channel
- Die plate



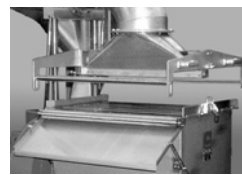
Cooling Trough

- Up to 2 m wide and 12 m long
- Two or more spreader bars
- Water flows opposite strand flow
- Vary temperature control
 - Multiple partitions or baths in series



Strand Drying

- Blowing, vacuum or a combination to remove water

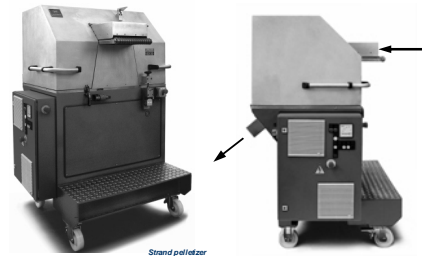


- Blowing nozzle
- Suction nozzles

Strand Pelletizer Features

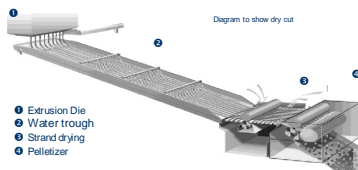
- Working widths 25 to 1000 mm
- Compact design, with easy access
- Belt driven for speed range adjustment
- Easily replaceable wear parts
- Most universal pelletizing system available
- Strand is not suitable for:
 - Processes with frequent strand breaks
 - Frequent starts, with high throughput rates

Strand Pelletizer, cont.



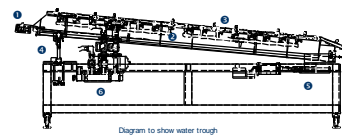
Automatic Strand Feed – Dry Cut

- Starts and stops without manual intervention
- Broken strands are automatically re-threaded
- No water between strands or on surface



Water Trough – Automatic Feed

- Water supply table ❶
- Water trough ❷
- Spray nozzles ❸
- Vertical trough adjustment ❹
- Horizontal trough adjustment ❺
- Water manifold ❻



Automatic Strand Components

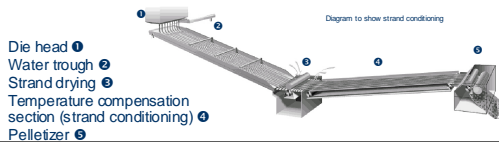
- Water supply table
 - Laminar water flow – defines thickness of the water layer
 - Table can be smooth or grooved
 - Swivel table to vertical plane
 - For startup – increase water flow by 30%
- Water trough
 - Slopes from 2 to 10 degrees
 - 2 to 7 m in length
 - Bottom must be smooth and can be covered
- Spray nozzles
 - Adjusted from “mist” to “spray”

Automatic Strand Components, cont.

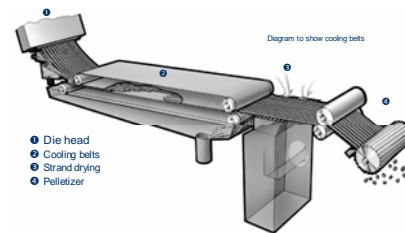
- Strand drying
 - Water separated by gravity
 - Water removed through slots by vacuum, blowing or both
 - Residual moisture levels of approximately 0.1%
 - Strand speed should not exceed 100 m/min
 - Airspeeds of 25 to 35 m/s
- Pelletizer is basically the same as for manual system
- Typical applications
 - Working widths from 100 to 1000 mm
 - Rates up to 800 kg/h – pellet temperatures 70 to 120 C

Strand Conditioning

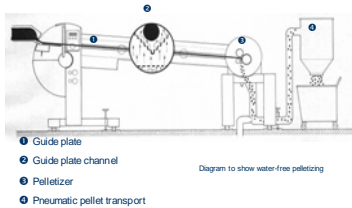
- Homogenizes the temperature of strand cross section.
- Clean pellet cut for glass filled materials.
- Pellet temperature reduced by 10 – 30 C.
- Lower residual moisture.



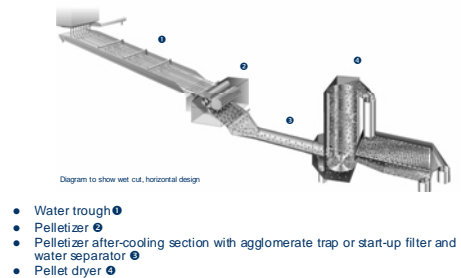
Cooling Belts



Water-Free Pelletizing



Strand, Wet Cut - Horizontal



Horizontal Strand Pelletizing

- Water trough – similar to dry cut, 1.5 to 7 m long
- Water Separation
 - Water separated by gravity before entering pelletizer
 - Water conveyed from dryer to coolant circuit
- Pelletizer
 - Housing must be waterproof – bearings should be sealed
 - Cutting tools – abrasion proof & corrosion resistant
 - Spray the cutting rotor to prevent pellet adhesion
- Pelletizer cooling section
 - Pipe kept half full – pre-drainage before the dryer

Horizontal Pelletizing, cont.

- Pellet dryer
 - Accelerate pellets mechanically onto sieves or rings
 - Centrifugal dryers and impact ring centrifuges
 - Fluidized bed dryers
- Applications
 - Working widths from 200 – 1000 mm
 - Strand speeds up to 250 m/min
 - Throughputs up to 12,000 kg/h
 - PET, PBT, PA, PC, ABS, PP

Vertical Strand Pelletizing – Wet Cut

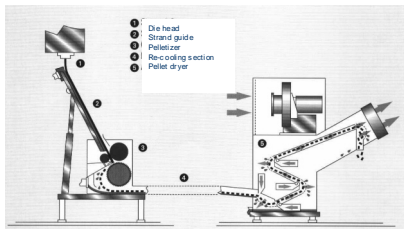


Diagram to show a wet cut system, vertical type

Vertical Pelletizing, cont.

- Strand guide and pelletizer form unit.
- Each strand has own guide groove.
- Normal heights between 2000 and 3600 mm.
- Working widths from 300 to 900 mm.
- Throughput rates up to 7500 kg/h.
- Brittle plastics, requiring short cooling sections.
- GPPS, HIPS, PMMA, SAN.

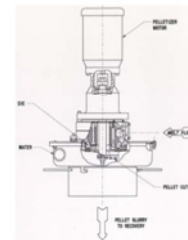
Water Ring Pelletizing

- No water at the die face – no die freeze
- Polymer cut in air – quenched in a ring of water
- Polymer must release from metal – olefins
- Pellets submerged in slurry – transported to dryer
- Die facing straight down or horizontal

Water Ring Pelletizing, cont.



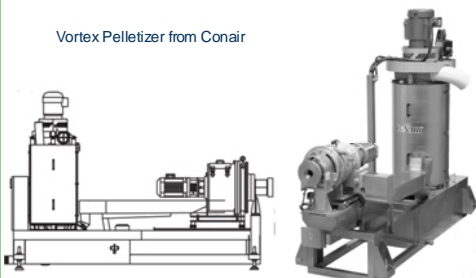
Beringer Water Ring Pelletizer.



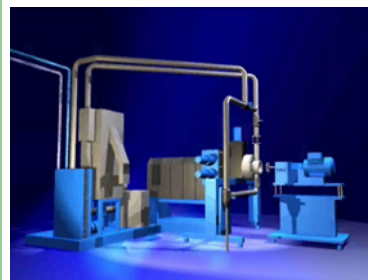
Detail of the Beringer Cutterhead.

Water Ring Pelletizing, cont.

Vortex Pelletizer from Conair

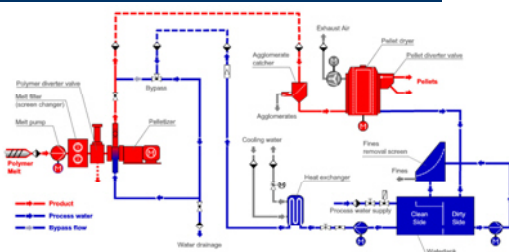


Underwater Pelletizing System



Skidmount for ARIBAT-1.04

P&I of Underwater Pelletizing System



Why are chips spherical, when an underwater pelletizing process is used ?



The molten polymer is cut into drops by the fast rotating blades of the pelletizer just when leaving the die holes and emerging into the process water. Because of the temperature difference between molten drops and process water, the polymer drops solidify. Due to the physical tendency to optimize the ratio of volume to surface area, a spherical shape is formed.

Advantages of the underwater pelletizing process

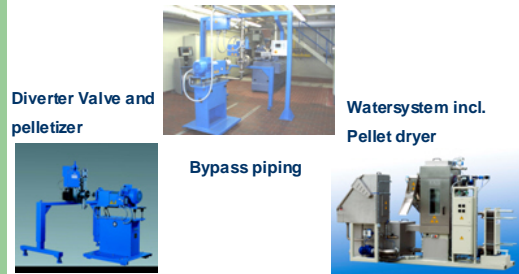
for PET chip production:

- ✓ Optimized chip shape
- ✓ Less cooling water needed
- ✓ Less space requirements
- ✓ Shortened solid staving
- ✓ Environmental advantages
- ✓ Ease of operation
- ✓ Less capital investment
- ✓ Lower operating costs

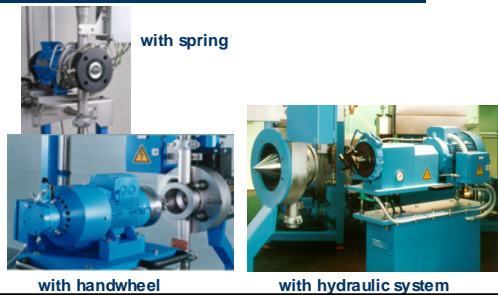
for PET chip end users:

- ✓ Higher bulk density
- ✓ Less bridging
- ✓ Better extruder feeding and shortened melt time
- ✓ More uniform and consistent intrinsic viscosity of the chips

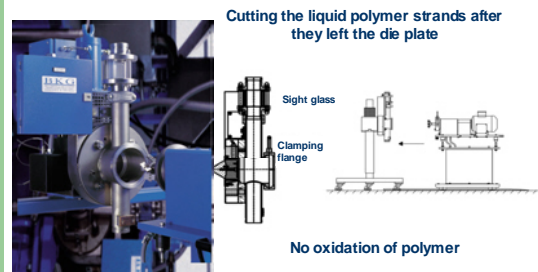
Main Components of an Underwater System



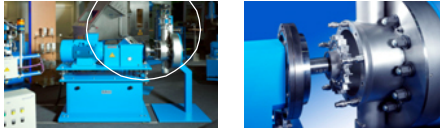
Different Types of Pelletizer Heads



Cutting Chamber and Pelletizer Head

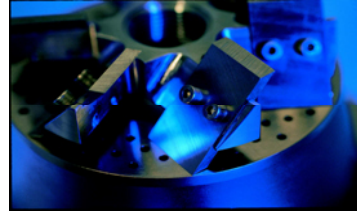


Pelletizer Features



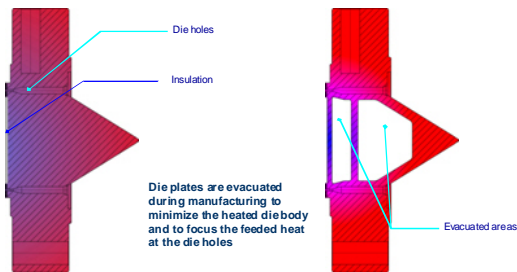
Automatic connection of the pelletizer to the cutting chamber

Die and cutter hub design



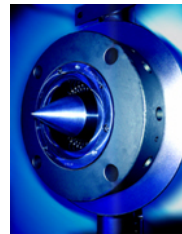
Exact blade adjustment ensures constant pellet quality

Special heat conduction of die plates



Optimized flow paths for the melt

Pressure reduced
flow channels

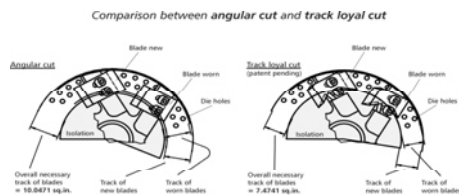


X-in-1
designs



Track loyal cut

Reduced area of die/cooling water interface contact



Improve of the heat transferability by requiring 25 % less cutting surface area and therefore increase of the lower induction of the die plate.

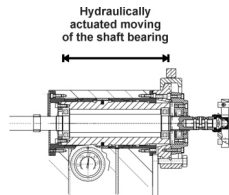
New development straight cut blades

Advantage:
Simple blade design
High number of blades possible
Specially used for micro pellets



Exact blade/die distance

- no tails at pellets
- no smearing polymer at the die
- underwater cut of even lowest viscosities
- extended blade life
- extended die plate life

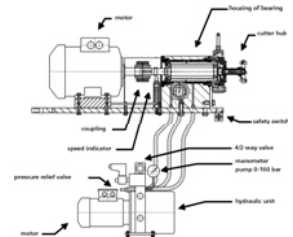


Hydraulic adjustment of cutter shaft

Determination of optimal hydraulic pressure to achieve optimized blade/die distance

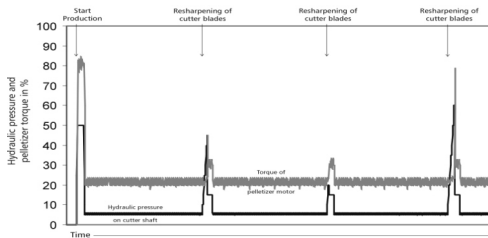
Automatic sharpening of pelletizer blades

Continuous cleaning of die plate during sharpening process



Hydraulic pressure adjustments

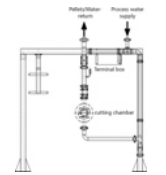
Hydraulic pressure is increased in certain time intervals (every 10, 30, 60 or ... minutes)



Bypass piping

The process water entry into the cutting chamber can be exactly timed by the bypass valves and the related PLC program.

This avoids a „freeze-off“ of the die holes (entry of process water too early) or an agglomeration of the pellets (entry of process water too late).



Watersystem incl. Pellet dryer



Self cleaning system for watersystem

Spray nozzles in the dryer



Fines removal sieve with cleaning system



Watersystem to feed 9 UWP for PA 6 Polymerisation



Underwater pelletizing Advantages

- Complete and state-of-the-art engineering
- Integration of up- and downstream equipment and processes
- Less scrap because of easy automatic controlled start-up
- Less freeze-off problems because of internal insulated die plate design
- Automatic sharpening of cutter blades
- Continuous cleaning of surface of die plate by rotary blades, no routine cleaning with stop is required
- Easy maintenance, no precise blade adjustment necessary, blades change within minutes

Pelletizing System Suppliers

Company	Pelletizing Products	Location
Gala Industries	Under Water	Eagle Rock, VA
Rieter Corporation	Under Water, Strand - Water Bath and Water Slide	Spartanburg, SC
BKG /Kreyenborg GmbH	Strand, Under Water	Atlanta, GA, Germany
Cumberland Engineering	Strand - Water Bath	South Attleboro, MA
Scheer Bay	Strand - Water Bath and Water Slide	Bay City, MI
Econ GmbH	Under Water	Greenville, SC/Austria