Process Lubrication for Aluminum Extrusion

Evolution of Aluminum Extrusion Process Lubrication

- Not so long ago, the extrusion industry utilized mostly manual and now outdated lubrication methods. Smoke, mist, and flame from grease and oil was quite the norm.
- The introduction of productivity advancements including the fixed dummy block, puller saws, log shears/saws, butt knockers, short-stroke front loading presses and others, are all driving automation of process lubrication.
- The continuing progression is now focused on improving plant safety, product quality, and process reliability with further advancements in lubricant dispensing systems and related best practices.

Topics Covered in this Presentation

- Where do we use lubricants in the aluminum extrusion process?
- Lubricant Types
- Common Lubricant Dispensing Methods
- Automatic Spray System Designs and Best Practices
Where do we use lubricants in the aluminum extrusion process?

- Billet and Dummy Block
- Hot Shears
- Die and Die Stack
- Pressure Seal Rings
- Saws

Billet and Dummy Block Lubrication

- Pre-cut Cold Billets
- Billets Cut at the Press
- Dummy Block – Conventional Press
- Dummy Block – Short Stroke Front Loading

Hot Shear Lubrication

- Log
- Butt Discard
- Butt Discard with Knocker
Die and Die Stack Lubrication

- Bearing for First Push
- Die Stack to Eliminate Snap Marks and as an Anti-seize

Pressure Seal Rings

- Die Ring
- Containing Ring

Saw Lubrication

- Cold Billet
- Hot Log
- Hot Profile
- Traveling Puller
- Cut-to-Length
- Precision
Lubricant Types for Aluminum Extrusion

Old Chemistry
- Acetylene Torch
- Solvents
- Petroleum Oils
- Graphite in a Variety of Forms

New Chemistry
- Boron Nitride – Powder, Waterborne Paints, Wax Dispersions
- Water Based Organic Solutions
- Synthetic Neat Oils

The newer options provide a cleaner, safer, more productive work environment with proper use.

Common Lubricant Dispensing Methods

Manual
- Swab
- Spray Wand
- High Pressure Low Volume (HPLV)
- Aerosol

Automatic
- Electrostatic Powder
- Pressurized Liquid with Atomizing Nozzles
- Injection Metering

Automatic dispensing systems necessitate appropriate design, installation, and maintenance.

Lubricant Types Matched with Automatic Dispensing Methods

<table>
<thead>
<tr>
<th>Description</th>
<th>Lubricant Type</th>
<th>Primary Applications</th>
<th>Secondary Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic Powder</td>
<td>Boron Nitride (BN)</td>
<td>Billet End</td>
<td>None.</td>
</tr>
<tr>
<td>Pressurized Liquid</td>
<td>Water Based Polymer</td>
<td>Billet End, Dummy Block, Butt Shear, Log Shear</td>
<td>Die Ring, Container Ring, Billet Scalper Tools</td>
</tr>
<tr>
<td>with Air Atomizing Nozzles</td>
<td>Liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Displacement</td>
<td>Synthetic Neat Oils</td>
<td>All Aluminum Sawing (and Machining)</td>
<td>Butt Shear and Log Shear</td>
</tr>
<tr>
<td>Injection Metering</td>
<td>and Water Based Polymer Liquids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Let's talk more about these lubricants and dispensing systems.
More About Boron Nitride (BN)

Hexagonal Boron Nitride (BN), the type used in aluminum extrusion, was introduced sometime in the late 90’s.

- Its unique platelet chemical structure is quite similar to graphite with improved lubricating properties, water solubility, and temperature stability.
- BN is non-conductive and relatively inert.
- BN is hygroscopic and will attract water. Once it has become wet, BN will agglomerate and not hold a charge.
- Electrostatically applied BN and modified BN powders are likely the most widely used billet and block lubricant/release agent.
- BN is expensive and a mess with improper use. Proper equipment dispensing design with ongoing preventative maintenance is required.

Basic Components for Electrostatic BN

- Controller
- Air Dryer
  - Primary
  - Secondary
- Hopper
- Powder Mixing
  - Auger vs Fluidizing Bed
- Injector
- Transfer Hose
- Spray Gun
- Grounding
- Dust Collection

Best Practices for Electrostatic BN

- Use only inorganic non-combustible powders.
- Eliminate all sources of water and humidity. Air in contact with powder must be dry.
- Insure proper grounding and charge transfer from gun to billet. Distance from gun to billet is key.
- Use powder collection with shaker down type vacuum filter. Do not reuse powder.
- Avoid packing powder. Transfer powder in small volumes. Use fluidizing bed style hopper, as opposed to auger type.
- Powder hose as short as possible and down hill from injector without bends.
- Disassemble and clean powder injector, powder hose, and electrostatic gun no less than weekly.
More about Water Based Polymers

- Introduced in the late 1980's to supplement acetylene sooters for automatic lubrication and clean up of fixed dummy blocks, these are generally described as water carried blends of soluble organic polymers and other compounds.
- Two product categories exist: solid film (high temp for billet, block, die and container ring) and liquid film (low temp for but shear and log shear).
- Water based polymers using manual and automatic spray equipment are in widespread use on billets, blocks, butt shears, log shears, die/container ring, and scalping.
- Early adopters utilized simple air over oil spray mist systems.
- Dispensing technology more specific to aluminum extrusion is now available.

Basic Components for Air Atomized Spray

- System Controls (Valve Package)
- Reservoir
  - Pressurized
  - Diaphragm Pump
- Interconnecting Air and Liquid Hose
- Atomizer with Spray Tips
- Spray Head Mounting
- Moving Assemblies

Best Practices for Air Atomized WBP

- Include an air blow out or purge for spray tips and assemblies.
- Strategically locate air pressure gauges for system troubleshooting.
- Filter liquid to avoid system clogging and output inconsistency.
- Diaphragm pumps are preferred in place of pressurized reservoirs. Insist on "lube free" pump.
- Liquid output is flow metered and output is pressure set. A flow restrictor can eliminate setup error.
- Use Stainless Steel where practical.
- Be sure liquid has corrosion inhibitors.
- A rotating nozzle is required for even and consistent coverage of billets and blocks.
Compare the Alternatives for Automatic Billet Lubrication

**Electrostatic BN**
- Easy to See Coating
- Use as Received
- Lubrication and Release
- Dust Can Be Vacuumed
- Does Not Tolerate Water
- Hard to Contain
- Hard to Troubleshoot
- Expensive with Overuse
- Expensive Repairs
- Hopper Must Be Close to the Spray Gun

**Atomized WBP**
- Tolerates Humidity
- Easy to Contain
- Repairs Generally Cost Less
- Reservoir Can Be Remotely Located from Spray Nozzle
- Relatively Easy to Troubleshoot
- Coating May be Hard to See
- Requires Mixing with Water
- Primarily a Release Agent
- Residue Can Only Be Washed
- Build Up in Area with Overuse

More About Synthetic Neat Oils

- This class of lubricants was first developed to replace flood coolants and conventional spray mist in machining and fabricating aircraft aluminum with high performance lubricants metered with precision dispensing systems.
- Fluids are typically a blend of synthetic esters, alcohols, and other high performance lubricant additives formulated to coat the tool surface using capillary action that is accelerated with heat.
- The heat of the cut is carried with the chip and the light chips are easily removed with air exhaust or blow off.
- The original technology, now over 25 years old, offered enhanced lubrication for better tool life and less burr as compared to conventional petroleum oils.
- Return on investment in the original technology was quickly paid for with increased tool life and improved chip value.
- There are many varieties available that are compatible heat treatment, anodizing, painting, hot metal cutting, and others.
- Dispensing equipment has evolved significantly.

Basic Components for Injection Metering Systems

- Injector (Piston Pump)
- Pulse Timing for Injector
- Gravity Reservoir
- Spray Pressure Regulator
- Liquid and Air Hose
- Spray Manifold and Tips
- Spray Head Mounting
- System Actuation (On/Off)
Best Practices for Injection Metering of Synthetic Oils

- Positive suction injectors are available to eliminate pump cavitation from air in liquid.
- Chemical resistant liquid contact seals, such as Viton (Dupont TM), insure long term performance and reliability.
- Specialized spray tips are available to generate high pressure to break blade air without mist or fog.
- Pressure regulate air flow at the spray tip.
- Spray Manifolds insure proper spray location and ease maintenance and repair.
- Liquid and air are mixed at the spray point (not at the injector).
- Biaxial liquid and air hose, rather than coaxial, can ease installation, maintenance and repair. PTFE is for high wear.
- Include reservoir options such as a fine mesh strainer to protect injectors, shut-off for pump repair, level indicators, and large capacity to reduce refill frequency.
- Include function to increase/decrease fluid output if required.

Best Practices Common to All Spray Equipment

- Use Clean and Reliable Air Source
- Avoid Contamination of Fluids/Powders
- Locate Spray Tip Close to and Directed at the Target
- Locate Controls and Reservoir for Access During Operation
- Safeguard Spray Nozzles
- Shorten All Hose Connections
- Determine and Maintain Appropriate System Settings
- Include Manual Over-ride for Testing of System
- Establish Lube Transfer/Fill Procedures, and Frequencies
- Establish Preventative/Predictive Maintenance
- Maintain Basic Repair Inventory
- Enclose and Contain Overspray
- Clean Spray Area and Equipment Regularly
- Train Related Personnel

How to Insure Safe Handling of Lubricants and Spray Systems

- Include a Simple and Quick Lock and Tag
- Use Appropriate Personal Protective Equipment
- Use Dust or Fume Collection
- Establish Preventative/Predictive Maintenance
- Enclose and Contain Overspray
- Clean Up Spray Area Regularly
- Train Related Personnel
Remember

Implementation technological advancements can improve safety, reliability, and efficiency with proper...

... design and installation.
... use of best practices.
... training of associated personnel.

Thanks for your time!