Coolant: Improving Quality to Eliminate Issues
Does cutting fluid have to go bad? Or can it last indefinitely…..

- **Key variables of virgin fluids** – How do we bake a cake? It starts with the right ingredients
  - Water soluble coolants
    - Make up water
    - Concentration control
  - Straight Oils
    - New vs. recycled
      - PPM & nitrification
New coolant quality – Make up Water

Make up water TDS – hardness
- TDS or Total Dissolved Solids levels should be in the 80 to 125 PPM (parts per million)
  - Test kits
  - Municipal office – water reports

Hard versus soft water
- Hard water binds additives intended to aid the cutting process & weakens the emulsion.
- Soft water increases the surface tension which tends to propagate foaming.
New coolant quality – Reduce TDS

1. Make up Water Controller
   - Automatically maintains TDS level in water stream by blending DI or RO with City water

2. Deionization System

3. Reverse Osmosis System
New coolant quality – Maintain concentration

Initial concentration ranges from 5% to 12%

Measurement methods

- **Refractometer**
  - Problem with skewed results from tramp concentration

- **Wet analysis**
  - chemical titration
Key variables of operating fluids – Who’s the enemy attacking our success

- Suspended Solids
- Tramp Oils
- Fungus, Yeast, & Mold
- Bacteria
- pH
- Temperature
Suspended Solids – Definition of threshold

- Target 50 PPM or less of solids larger than 40 micron.
problems with increased solids levels

- Pulls desirable coolant additives from solution and binds them up rendering them useless to the cutting process.
  - Wetting agents
  - Lubricating agents
  - Anti-oxidation agents

- Leads to propagation of bacteria.
- Surface area with 1” to 2” of sludge in tank bottom can increase tank surface area exponentially.
Tramp Oils – Hydraulic, spindle, & way lubricants

- Target 20 PPM or less of free mechanically emulsified oils (point at which sheen becomes visible on surface)

- Mechanical versus chemical emulsification

  - In a quiescent zone, mechanicals free up to the surface where chemically emulsified oils are held with an electro chemical bond to coolant molecules.
Bacteria – the good, the bad, & the ugly facts

- Anaerobic bacteria
  - Sulfur reducing which creates Hydrogen Sulfide that creates the “rotten egg” smell.
  - Drives the pH down which strips corrosion inhibitors.
  - Feeds Fungus, Yeast, and Mold.
    - Creates a “sour milk” smell.
    - Very dangerous to human exposure!
Bacteria – the good, the bad, & the ugly facts

- **Aerobic bacteria**
  - Helps keep pH more stable, controls Fungus, Yeast, and Mold.
  - Kept active by proper filtration and aeration of coolants thru circulation.
Bacteria – the good, the bad, & the ugly facts

BIO SLUDGE:

- Bacteria are living organisms with cell tissue that eat organics and secrete waste.
- They die leaving their bodies behind to circulate in the sump and this sticky slimy mess builds on all surfaces further propagating bio growth, plugging up filters, small orifices, and way slides.
**pH Values**

**What is it?**  pH is a measure of the acidity or basicity of a solution. It is defined as the cologarithm of the activity of dissolved hydrogen ions (H+).

- Ideal range typically between 8.0 to 9.5
- Test methods are simple test strips
- Well circulated systems can be raised with soda ash or amines
- Good filtration and aeration (circulation)
Basic law of physics’s “Energy is neither created nor destroyed”.

Heat comes into the fluid from two main sources

- Spindle horse power through the cutting tool
  - Typically 10% of the spindle horsepower Kilowatts are realized over time as heat.

- Pumping horse power circulating the cutting fluid
  - Typically 100% of the pump motor Kilowatts are realized over time as heat.
Temperature - affects from variance

- Temperature affects cutting process relating to **sizing of parts**, **wear of tools**, and **bacteria growth**.
- Ideal temperature range based on metals is typically held in the 75 degree to 87 degree range.
- Bacteria growth increases exponentially in the 85 to 110 degrees* Fahrenheit.

Increased temperatures lead to increased bacteria growth*
What happens when these variables go out of range?

- **SCRAP** - Poor part tolerance i.e. low FTQ (first time quality) or productivity

- **Machine Breakdown**
  - Premature failure of way covers and seals
  - Ball screw failures
  - Spindle failures
What happens when these variables go out of range?

- Excessive down time to clean, repair, & maintain machine

- Frequent down time to pump out, de-sludge, and refill coolant tanks
Poor Coolant Fluids can lead to Broken tools, scrap parts, short tool life

**Wear patterns of cutting edges**

1. Built Up Edge phenomenon
2. Chipping Wear
3. Flaking
4. Spalling
5. Fracture
6. Flank / Nose / Face Wear
7. Notching Wear
8. Thermal Cracking (Shock) (Fatigue)
9. Crater Wear (Diffusion Wear)
10. Deformation Wear
11. Cobalt Leaching
12. Abrasive
13. Attrition
How do we keep a balanced process?

What every good coach preaches –
- follow the fundamentals

Rules of thumb for Success:
- Filter solids before oil, oil before temperature, temperature before return to cutting zone.
- Aerate the entire sump ALL the time.
It Starts with the right Design

JKI’s laws of coolant management

- Get the dirt to the filter
- Make the filter bigger than the dirt load
  - Make sure it’s serviceable given the environment
- Create a filtration scheme that works together
  - JKI’s patent pending filtration process
How it works

We use a stepped process to achieve efficient filtration

- 1st stage – primary chip conveyance
  - Hinged belt, drag type, or combination.

- 2nd stage – coarse filtration (80 micron)
  - Rotary drum, magnetic, or combination.

- 3rd stage – medium filtration (60 micron)
  - Centrifugal separator

- 4th stage – fine filtration (10 to 30 micron)
  - High capacity cartridge type filter

- 5th stage – aeration & recirculation
Flow Schematic

CNC Machine

Tramp oil separation - refrigeration
Medium filtration (60 micron)

How they work
High velocity influent passes through the separator, which is designed to produce a circular flow pattern. Using gravitational force, metal fines migrate to the separator’s side walls and downward, into a solids holding chamber. Cleansed effluent rises up, through the vortex and is returned back to the system. Subsequently, the separated solids are purged from the holding chamber, continuously, manually or automatically, depending on what type equipment is utilized.

Features & benefits
Removes 98% of all solids with a 1.8 specific gravity or more greater than 60 micron in size
Rated for pressures to 150 PSID
Rated for temperatures to 200°F
Epoxy coated, carbon steel construction
Fine Filtration (10 to 30 micron) Filter Elements

- Broad range of media types including
  - Melt blown polypropylene
  - Polyester felts
  - Cellulose
  - Nomex (high temperature)
  - Spun bond polyester & nylon
  - Nylon mesh (single & multi filament)
  - Stainless Steel mesh
The results:

Before

After
Summary

- Following the fundamentals will provide coolant life for a year or more!

- **put a lot of money to the bottom line!** – by improving quality, productivity, ROI, and making a positive impact on the environment!