MANUFACTURING INSIGHTS

MINIMUM QUANTITY LUBRICATION

Success Stories in Minimum Quantity Lubrication

SCENE 1.
CG: FBI warning
white text centered on black to blue gradient

SCENE 2.
SME logo, with music

SCENE 3.
Manufacturing Insights open, with music
narration

MUSIC UP AND UNDER

NARRATION (VO):

MANUFACTURING INSIGHTS,

MANUFACTURING ENGINEERING MAGAZINE'S VIDEO SERIES FOR PROCESS IMPROVEMENT.

SCENE 4.
CGS: MINIMUM QUANTITY LUBRICATION

Ford shots?

NARRATION (VO):

THIS PROGRAM WILL EXPLAIN HOW THE CONCEPT AND PRACTICE OF MINIMUM QUANTITY LUBRICATION, OR MQL, HAS BEEN INTEGRATED BY MANUFACTURERS THAT CUT AND FORM METAL.

SCENE 5.

prev. scene cont'd

NARRATION (VO):

FIRST, WE'LL INTRODUCE SOME CONCEPTS BEHIND NEAR-DRY MACHINING AND MQL. THEN WE'LL INVESTIGATE HOW THE CONCEPT IS BEING PUT INTO PRACTICE...

SCENE 6.

CGS: Amerimax Home Products

NARRATION (VO):

...AT AMERIMAX HOME PRODUCTS, WHOSE METAL-

punch press line 04.22.33

FORMING OPERATIONS PRODUCE VARIOUS ROOF-DRAINAGE PRODUCTS...

SCENE 7.

CGS: World Machinery

02.10.55 -

NARRATION (VO):

...AT WORLD MACHINERY, A SUPPLIER OF SAW SYSTEMS FOR METAL CUTTING...

SCENE 8.

CGS: Advanced Mold

02.27.05 -

NARRATION (VO):

...AT ADVANCED MOLD, A MAKER OF MOLDS FOR MULTIPLE INDUSTRIES...

SCENE 9.

CGS: Ford Motor Company

Ford shot inside machining center cutting part

NARRATION (VO):

...AND AT FORD MOTOR COMPANY, WHICH USES MQL AT ITS POWERTRAIN MANUFACTURING PLANTS TO MACHINE COMPLEX, HIGH-VOLUME PARTS.

--- TOUCH BLACK ---

SCENE 10.
CGS: NEAR-DRY MACHINING

AND MINIMUM QUANTITY LUBRICATION (MQL)

Drilling with MQL at Unist

01.30.20 -

NARRATION (VO):

IN VARIOUS METAL MACHINING AND FORMING PROCESSES, THERE ARE WAYS OF DRAMATICALLY REDUCING HOW MUCH LUBRICANT OR COOLANT IS USED. THESE METHODS ARE USUALLY GROUPED UNDER THE TERM “NEAR-DRY MACHINING” -- OR MORE INCLUSIVELY, “MINIMUM QUANTITY LUBRICATION.” MQL COMPRISES TECHNOLOGIES AND PRACTICES FOR APPLYING SAFE MACHINING FLUIDS EFFICIENTLY, ONLY AT THE LOCATIONS AND IN THE AMOUNTS THAT ARE NEEDED FOR THE PART AND PROCESS.

Amerimax misting with MQL on roll form or punch press sheet

0X.YY.ZZ -

MQL CAN BE APPLIED TO MULTIPLE MANUFACTURING OPERATIONS, SAYS JEFF COFFEY, PRODUCT ENGINEER AT UNIST ["YOU-NIST"] INC., IN GRAND RAPIDS, MICHIGAN.

SCENE 11.
Coffey 01.02.54 – 03.15

CGS: Jeff Coffey

Product Engineer

UNIST Inc.

COFFEY, ON CAMERA:
MQL is a little bit bigger umbrella than near dry machining. MQL can also apply to the amount of lubrication needed for sheet metal forming operations, blanking, forming, cutting, anything along those lines. Near dry machining is more specific to machining operations such as mills, drills, turning operations, tapping.

SCENE 12.

Background image: 01.36.10 -36.40 sequence of drilling tapping, reaming at Unist

CGS Overlay bullet points on screen:

Reduced fluid consumption

Safer fluids

Reduced health hazards

Faster machining

Longer tool life

Lower disposal costs

Cleaner shop environment & reduced maintenance

NARRATION (VO):

EFFICIENT, ENVIRONMENTALLY-FRIENDLY PRACTICES OF NEAR-DRY MACHINING CAN CREATE SEVERAL KINDS OF COST SAVINGS AND IMPROVEMENTS FOR A MANUFACTURING SHOP, INCLUDING:

SIGNIFICANTLY REDUCED FLUID USE...

SAFER CUTTING FLUIDS & LUBRICANTS...

FEWER EMPLOYEE HEALTH HAZARDS...

FASTER MACHINING SPEEDS & FEEDS...

LONGER TOOL LIFE...

LOWER FLUID DISPOSAL COSTS...

A CLEANER SHOP AND REDUCED MAINTENANCE.

SCENE 13.

Ford B-roll, interior of machining center machining transmission cases—chips flying

NARRATION (VO):

BOTH LARGE & SMALL COMPANIES CAN REAP THE ADVANTAGES OF NEAR-DRY MACHINING, EVEN THOUGH

THEIR TRADITIONAL COOLING METHODS MAY STILL BE EFFECTIVE. THE TRADITIONAL METHOD IS TO FLOOD THE TOOLING WITH A COOLANT MIXTURE.

SCENE 14.
Furness

CGS: Rich Furness

Manager

Advanced Manufacturing Technology Development, Powertrain

Ford Motor Company

FURNESS, ON CAMERA:
It is commonplace still today in many industries to use coolant as a means to support the cutting operation, providing a function for lubrication between the cutting tool and the workpiece, a means to transport chips out of the machine, and also a means to stabilize the temperature of the work part and also the machine tool. It is quite effective in all those aspects, but there are an awful lot of environmental burdens and costs associated with using cutting fluids.

SCENE 15.

01.36.10 -36.40 sequence of drilling tapping, reaming at Unist

NARRATION (VO):

FLOOD COOLANTS ARE ASSOCIATED WITH SEVERAL COST AND SAFETY ISSUES: THEY TYPICALLY REQUIRE A SUMP SYSTEM FOR HANDLING, THEY ARE PRONE TO BIOLOGICAL DEGRADATION, AND EVENTUALLY THEY MUST BE DISPOSED OF. ALL THESE ISSUES SHOULD BE CONSIDERED WHEN JUSTIFY MQL.

SCENE 16.
Coffey 01.07.38 – 07.58

COFFEY, ON CAMERA:
The first thing people are going to be looking for is cost. Does it make sense to switch technologies and go through the pain of learning something new from a financial perspective? The second thing is the environment. The environment is becoming more and more of a concern for corporate America in general. The third is for employee health and safety.

SCENE 17.

Ford machining center machininig transmission case

NARRATION (VO):

LOWER PRODUCTION COSTS IS AN OBVIOUS GOAL, SINCE COOLANT-RELATED COSTS MAKE UP A SIGNIFICANT COMPONENT OF TOTAL MANUFACTURING COSTS.

IN STANDARD AUTOMOTIVE POWERTRAIN MACHINING,

FOR EXAMPLE, FORD HAS ESTIMATED THAT COOLANT COST CAN BE WELL OVER TEN PERCENT OF TOTAL COSTS -- ROUGHLY TWICE AS MUCH AS THE COST OF THE CUTTING TOOLS.

MOREOVER, ONLY ONE QUARTER OF THE COOLANT COST IS FOR THE RAW LUBRICANT ITSELF. THE REST IS FOR **FLUID AND SYSTEM MAINTENANCE -- INCLUDING, SPECIFICALLY, FLUID CHEMICAL TREATMENT COSTS, FILTER MEDIA COSTS, ENERGY COSTS FOR PUMPS AND CHILLERS, AND THE BURDENS OF CLEANING AND REPAIRING PUMPS, PIPES, AND TANKS.**

SCENE 18.
Coffey 01.08.32 – 09.11

COFFEY, ON CAMERA:
Flood coolant is basically a mixture of water and oil. At the end of its life, it's not something you can just throw out in the backyard, any more than you can throw out an oil change in your backyard when you change the oil on your car. When you multiply that by hundreds or thousands or tens of thousands of gallons a typical plant will go through at the end of the life of the coolant, it's a significant factor that you're disposing. It's considered toxic waste. Tossing toxic waste out by the barrels is something we think of as happening in the 1950s. It's still happening today.

SCENE 19.

NARRATION (VO):

Any footage of coolant containers at Ford? **Or dirty filter media and wet chips**

THE PROBLEM OF FLUID DISPOSAL IS CLEAR, ESPECIALLY WHEN CONSIDERING THE IMMENSE VOLUMES OF FLUIDS USED IN METALWORKING: APPROXIMATELY 600 MILLION GALLONS WORLDWIDE EACH YEAR, AND 175 MILLION GALLONS IN THE U.S. ALONE.

At Ford, girl operator pushing button at panel at machining center

ALONGSIDE THE DISPOSAL ISSUE ARE THE HEALTH

AND SAFETY CONCERNS OF WORKERS EXPOSED TO

THESE FLUIDS, SAYS COFFEY.

SCENE 20.
VO: Coffey 01.10.12 – 11.02

pan of roll-forming line 04.27.35 – 28.00 – show guy packing long parts at end of line

cut to:

UNIST footage of mist sprayed on cardboard 01.31.30 –

COFFEY, VO:
From traditional flood coolant, there are two main concerns. The first is with skin. Dermatitis issues are prevalent in the industry, and that's a result of the petroleum based fluid being in contact with your skin. There are also many biocides and other things in cutting fluids to help prevent bacterial growth. Bacteria loves water, and to prevent that from happening you need to put a lot of antibacterial and biocidal type ingredients in your cutting fluids. That reacts with people's skin. It also reacts with people's lungs. People are breathing in that air particulate. Surprisingly, you have more air particulate, dirtier air, poorer air quality, with a flood cooling operation than you do with MQL where you're spraying a mist.

SCENE 21.

Ford pan showing their clean floors, aisles, machines, etc. **Could also add dry-chips shot**

NARRATION (VO):

AT THE FORD LIVONIA, MICHIGAN PLANT, THE CLEAN

ENVIRONMENT CREATED BY NEAR-DRY MACHINING IS

EVIDENT. THIS IS MUCH DIFFERENT FROM OTHER

OPERATIONS THAT DON'T USE MQL.

SCENE 22.

Furness 0.0.0 – 0.

FURNESS, ON CAMERA:
We have very large scale fluid systems to support high volume machining lines, and the systems require extensive maintenance and they consume a lot of energy with the pumps and chillers and filtration systems and mist collection systems associated with their use. They also burden our facilities with potential safety concerns, where small leaks can lead to workplace hazards for trips and falls by the personnel in the production facility. Then there is the associated management of spent fluid, which is another cost.

SCENE 23.

–

Montage of footage from Amerimax, World Saw and Advanced Mold

NARRATION (VO):

HOWEVER, BEFORE WE STUDY HOW MQL IMPROVED THE

OPERATIONS AT FORD, LET'S SEE HOW A FEW

SMALLER OPERATIONS HAVE INTEGRATED BASIC MQL

WITH VARIOUS METALWORKING OPERATIONS AND EQUIPMENT.

-- TOUCH BLACK --

SCENE 24.
Amerimax sign PB

04.03.16 –

CGS:Amerimax Home Products, Inc.

Lancaster, PA

NARRATION (VO):

MQL ANSWERED BOTH THESE COST AND SAFETY CONCERNS AT AMERIMAX HOME PRODUCTS, A MANUFACTURER OF ROOF DRAINAGE PRODUCTS, SUCH AS GUTTERS AND DOWNSPOUTS. THESE PARTS ARE PRESS-FORMED AND PUNCHED FROM STEEL AND ALUMINUM SHEET METAL.

drip/spray lube on sheet going into punch press 04.22.33 -

HERE, MQL PRIMARILY ANSWERED THE SAFETY CONCERNS THE COMPANY HAD ABOUT ITS WORKERS. THE SHOP'S PREVIOUS LUBRICATION METHOD EXPOSED OPERATORS TO A MIST OF VANISHING OIL IT ONCE USED IN ITS OPERATIONS.

SCENE 25.
Kehs 04.15.47 – 16.04

CGS: Vincent Kehs

Senior Process & Materials Engineer

Amerimax Home Products, Inc.

KEHS, ON-CAMERA:
We actually had a cloud over the top of the machinery, because of the lubrication. By putting air behind the mist it ionized and was throughout the atmosphere, and that created a safety issue, and that's why we went to MQL.

SCENE 26.

04.19.40 – 20.00

or 04.28.30 -

zoom to sheet metal thru Unist unit

NARRATION (VO):

FOR LUBRICATING SHEET METAL BEFORE IT ENTERS PROGRESSIVE DIE PRESSES AND ROLL-FORMERS, AMERIMAX CHOSE A UNIST UNIROLLER SYSTEM. UNLIKE A CONVENTIONAL LUBRICANT SPRAY SYSTEM WHICH CREATES HARMFUL V.O.C.'S, THE ROLLERS APPLY ONLY ENOUGH OIL TO FORM THE PART AND

PROLONG TOOL LIFE.

SCENE 27.
Hall 04.06.20? – ?

CGS: Bill Hall

UNIST Inc. Representative for Ohio and Western Pennsylvania

HALL, ON CAMERA:
A number of the fluids they use are a vanishing oil and they had VOC limitations where they didn't want to get this in the atmosphere. Also, with the spray systems, they were unable to apply fluid accurately on the bottom of the coil stock. With the roller systems we were able to apply a very even, small amount of fluid top and bottom, and able to carry that all the way through to the end of the progressive die.

SCENE 28.

PB of Unist B-roll footage of Uniroller 01.26.10 -

HALL, VO:
[VO: Hall 04.10.37 – 10.55]Traditionally, roll forming operations always used to have drip cans, flooding systems, spray systems. Quite honestly, applying minimum quantity of fluid on a roll forming operation is somewhat new, but many companies have integrated this into their procedure.

SCENE 29.

close-up of rollers 04.36.10 –

NARRATOR, VO:

REDUCTIONS IN OIL USAGE HAVE ALLOWED THE MQL

UNITS TO PAY FOR THEMSELVES.

SCENE 30.
Kehs 04.17.39 – 17.48

KEHS, ON CAMERA:
We feel the major concern was the safety issue, but we also feel the reduction in oil usage probably paid off in one year's time.

SCENE 31.

04.26.05 – 26.25 PB of sheet in

punching press

NARRATOR, VO:

GIVEN THE FINANCIAL VIABILITY OF MQL, AND THE

CLEANER SHOP ENVIRONMENT AS WELL, THE COMPANY

IS CONSIDERING USING MQL FOR OTHER SHOP

APPLICATIONS – PARTICULARLY FOR PRESS

OPERATIONS THAT PERFORATE SHEET METAL.

SCENE 32.

prev. scene cont'd

Kehs 04.17.55 – 18.13

KEHS (VO or On Camera):

Especially in the perforation and punching operations, we try to use MQL for all those issues. Any time a new product will come up, we will continually add and purchase new units.

-- TOUCH BLACK –

SCENE 33.

02.26.15 – 26.24 exterior sign of World Machinery

CGS: World Machinery and Saw Systems

Vernon, California

02.14.40 – 15.00 Zoom of saw cutting with MQL nozzles

02.15.05 – 16.10 Unist unit CU then PB to show unit

NARRATION (VO):

AS INTEGRATED BY WORLD MACHINERY AND SAW SYSTEMS, MQL SYSTEMS ARE EFFECTIVE WHEN USED IN ONE OF THE MOST BASIC – AND RIGOROUS – METAL-CUTTING PROCESSES.

WORLD MACHINERY SPECIALIZES IN PROVIDING SAW MACHINES FOR CUTTING METAL TUBE AND BAR STOCK. OVER THE LAST TEN YEARS, THE COMPANY HAS BEEN CONVERTING COLD-SAW SYSTEMS BUILT WITH FLOOD-TYPE COOLING INTO MQL SYSTEMS, BY ADDING HARDWARE FROM UNIST. OWNER MICHAEL YOUNG SAYS CUSTOMERS HAVE GRADUALLY COME TO APPRECIATE AND EXPECT THIS EQUIPMENT ADDED ONTO THEIR SAW SYSTEMS TO SUPPORT MQL.

SCENE 34.
Young 02.06.28 – 06.43

CGS: Michael Young

Owner

World Machinery & Saw Systems

YOUNG, ON CAMERA:
We have many people that have some idea already what it is, and when they buy, they exercise the option to install. And we have some who already have some other system, like the flooding system, and wanted to change.

SCENE 35.

01.13.00 – CU with nozzle

NARRATION (VO):

UNLIKE WITH FLOOD COOLING, THE MQL SYSTEM APPLIES SMALL VOLUMES OF LUBRICANT TO EACH SIDE OF THE SAW BLADE USING A POSITIVE DISPLACEMENT PUMP AND SPLITTER NOZZLE. **THIS**

ADEQUATELY LUBRICATES THE BLADE.

SCENE 36.
Tivelby 01.24.15 – 24.29

CGS:**Shawn TeVelde**

National Sales Manager

UNIST Inc.

TEVELDE, on camera :
If we can apply a very effective lubricant to a cutting tool, this being a saw blade, we can stop heat from being generated in that cutting tool, or saw blade, and eliminate flood coolant and extend tool life.

SCENE 37.

01.17.00 – 17.10 PB of guy holding bar, sawing at machine

01.18.40 – shows debris under blade

NARRATION (VO):

AS WITH MQL IN FORMING, PUNCHING, **AND METAL REMOVAL**, MQL IN SAWING REDUCES OR ELIMINATES THE PROBLEMS OF MESSY WORKSPACES, ODORS, SKIN IRRITATIONS, AND OTHER WORKER HAZARDS. IT ALSO REMOVES THE POTENTIAL OF PARTS BEING CONTAMINATED, OR EVEN RUSTED, BY WATER-SOLUBLE COOLANTS.

01.42.20 – sawing at Unist

THESE ADVANTAGES TYPICALLY OUTWEIGH THE EXTRA COSTS OF MQL-ENABLED SAW SYSTEMS. EQUIPMENT COSTS IN THIS APPLICATION ARE TYPICALLY UNDER A THOUSAND DOLLARS PER SAW, OR ROUGHLY 10% OF THE TOTAL SAW SYSTEM PRICE. THESE COSTS REFLECT THE RELATIVELY LOW INVESTMENT NEEDED FOR SOME SMALL-SCALE, ENTRY-LEVEL MQL SYSTEMS.

OVERALL, NEAR-DRY SAWING MIGHT BE VIEWED AS APPLYING THE SAME CONCEPTS AS OTHER MQL MACHINING PROCESSES.

SCENE 38.

01.12.50 – CU of edge of saw blade cutting

TEVELDE, VO:
(01.24.15 – 24.29) Sawing is like machining, same type of thing, just different scale. MQL works great in machining. Sawing is a simpler form of that. It’s the same concept. It works across the board, in metal cutting in general.

-- TOUCH BLACK –

SCENE 39.
03.15.45 – 15.50 exterior—sign

NARRATION (VO):

THE MATERIAL-REMOVAL PROCESSES USED BY MOLD-MANUFACTURER ADVANCED MOLD TECHNOLOGY IN BREA, CAILFORNIA ALSO BENEFIT FROM MQL.

02.30.45 – 31.00 zoom into overall milling setup

ADVANCED MOLD PERFORMS 3-AXIS MILLING TO CUT MOLDS MADE FOR COMPRESSION, INJECTION, AND LIQUID-INJECTION RUBBER MOLDING FOR THE AEROSPACE, MEDICAL, AND CONSTRUCTION INDUSTRIES.

03.11.10 – edge machining of mold

MOLD-MAKER SERF SOTELLO SAYS MQL IS INCORPORATED IN ALL MILLING STEPS FOR CUTTING HARDENED MOLD STEELS.

SCENE 40.
Sotello 03.04.14 – 04.25?

CGS:Serf Sotello

Mold Maker

Advanced Mold Inc.

SOTTELLO, ON CAMERA:
We use it throughout our whole milling operation, from roughing to finish. It provides great tool longevity, even in roughing.

SCENE 41.

NARRATION (VO):

01.31.32 – shows Unist unit in pan/PB

USING MQL TO APPLY CUTTING OIL HAS PROVIDED SEVERAL BASIC PRODUCTION BENEFITS.

SCENE 42.

Sotello 03.07.24 – 07.33

SOTELLO, (ON-CAMERA AND VO) :
Using the Unist system we have increased speed rates and RPMs, which also increased the chip removal amount, so it has been a big plus for us.

(VO 03.06.38 – 06.58) That system has greatly increased our tool life. I've just noticed we can use it for roughing and finishing. Our roughing end mills last ten times longer than they used to. Finishing, it's just

02.34.25 – 35.00 machining of pins

outstanding on finishes, way better than soluble oil.

SCENE 43.

03.11.10 – edge machining of mold

NARRATION (VO):

THERE HAVE ALSO BEEN SIDE BENEFITS FROM SWITCHING AWAY FROM WATER-SOLUBLE OIL.

SCENE 44.

Sotello 03.04.59 – 05.15

SOTELLO, ON CAMERA :

Before we used to use the basic soluble oil mixture that would go rancid every three to six months. We'd have to replace it, and it was a mess, and it was hard to deal with.

SCENE 45.

02.39.28 – 39.48 Pan from nozzles & hoses

NARRATION (VO):

MOREOVER, THE CALIFORNIA PLANT FACES PARTICULARLY STRICT ENVIRONMENTAL LAWS, MAKING THE DISPOSAL OF WASTE OIL COSTLY. HERE, MQL IS A METHOD OF COST-AVOIDANCE, SAYS UNIST'S JEFF COFFEY.

SCENE 46.

Coffey 01.19.15 – 19.46

02.42.18 – 42.28 cutting tools

COFFEY on camera & VO:

In California, fluid disposal is a bigger issue than in a lot of other states. With Advanced Mold, the fluid disposal costs, just in themselves, saved more money than it cost to completely change over their coolant systems from their flood operations to MQL. In addition to that, the tooling savings they are seeing in terms of their tool life increasing a couple of fold, those are also big incentives for them to continue, and it gives them a competitive edge.

SCENE 47.

02.50.00 – 50.37 Zoom to show cutting of surface patterns

NARRATION (VO):

ADVANCED MOLD DOES FACE STIFF COMPETITION FROM OTHER SHOPS —- INCLUDING HIGH-SPEED MACHINING OPERATIONS THAT HAVE TOTALLY ELIMINATED FLUID FROM THEIR PROCESSES. BUT THESE "DRY" SHOPS MAY BE MISSING OUT ON THE BENEFITS THAT COME

FROM APPLYING JUST A SMALL AMOUNT OF VEGETABLE OIL LUBRICANT WITH A NEAR-DRY SYSTEM.

SCENE 48.
02.45.00 - CU of prev. scene cont'd

01.31.10 - Unist B-roll showing drill stopping and oil steaming off it

COFFEY (VO) :
(01.21.41 – 22.00) As far as high speed machining, especially in the operations that are typically done dry, adding a little bit of lubricant to that same operation often increases their tool life by significant amounts. And it's important to use vegetable oil, because vegetable oil alleviates thermal shock that you would normally see with a water based coolant.

-- TOUCH BLACK --

SCENE 49.

At Ford, pan of MQL shop showing multiple machining centers and conveyors, gantries, etc.

NARRATION (VO):

THE APPLICATION OF NEAR-DRY MACHINING BY FORD MOTOR COMPANY HAS RESULTED IN MANY OF THE BENEFITS SEEN BY SMALLER COMPANIES – AT A MUCH LARGER SCALE. AND DESPITE THE HIGHLY AUTOMATED, HIGH-VOLUME ENVIRONMENT, MANY OF THE LESSONS LEARNED BY FORD ARE APPLICABLE ACROSS ALL THE METAL-WORKING PROCESSES THAT USE MQL, FOR OPERATIONS OF ALL SIZES.

FORD'S BIGGEST STEPS IN NEAR-DRY MACHINING HAVE BEEN MADE AT ITS MICHIGAN TRANSMISSION PLANTS. **AT ITS LIVONIA AND VAN DYKE PLANTS,** EFFORTS WERE DIFFICULT BECAUSE OF THE COMPLEXITY OF THE PARTS IT MACHINES AND BY THE AUTOMATION IN ITS PRODUCTION MACHINING LINE, WHICH UNITES SEVERAL MACHINE TOOLS IN A CONTINUOUS PROCESS. SINCE MQL IS BEING USED ON MULTIPLE MACHINES ON THE SAME LINE, EACH CHOICE ABOUT HOW TO INCORPORATE NEAR-DRY

TECHNOLOGY HAS BEEN CRITICAL – ESPECIALLY WHEN THE GOAL IS "100% MQL" FOR ALL MACHINING OPERATIONS.

ACCORDINGLY, FORD'S INTEGRATION OF NEAR-DRY MACHINING REQUIRED SEVERAL YEARS OF DEVELOPMENT. IT WAS INITIALLY DRIVEN BY SPECIFIC GOALS THAT CENTERED ON THE ELIMINATION OR REDUCTION OF COOLANT USE, SAYS RICH FURNESS.

SCENE 50.

Furness

FURNESS, ON CAMERA:
The objective to eliminate the coolants or minimize their use in production became a goal in the mid 1990s, and really became a viable objective in the late 1990s, early 2000s. This was driven by concerns over the environmental impact of fluids, their cost, and also the health and safety of the workplace.

SCENE 51.

Machining inside machine center

NARRATION (VO):

EARLY MQL DEVELOPMENT DEPENDED ON THE TEAM EFFORT OF DIFFERENT AUTOMOTIVE MANUFACTURERS IN NORTH AMERICA AND EUROPE.

SCENE 52.

Prev. scene cont'd

FURNESS, (VO) :
In North America, Ford was involved in a consortia project with other end users such as General Motors and Chrysler, focused on dry machining for the core powertrain components that Ford and those other companies manufacture. At the same time consortia efforts began in Europe directed at minimum quantity lubrication machining technology. Very early on in the efforts in the U.S., we found that dry machine of aluminum was really not going to be viable for anything except open faced cutting. By that I mean operations like milling. For the majority of the machining operations that we do, drilling,

reaming, tapping, hole-making processes, you need to have lubricant, and the development taking place in Germany really found a viable solution for that. So we focused our attention in that area, and began to push quite aggressively to bring that technology into production to fulfill our objective of to minimize or eliminate coolant use.

SCENE 53.

Machining of trans cases in machine – alt. angle

09.16.00 – 25 Parts of interest on table at Bielomatik

NARRATION (VO):

FORD POWERTRAIN HAS A NUMBER OF MACHINING OPERATIONS THAT WOULD TRADITIONALLY REQUIRE FLOOD COOLANT. OPERATIONS FOR TRANSMISSION COMPONENTS, PRIMARILY MADE OF ALUMINUM, BECAME THE MAIN FOCUS OF MQL DEVELOPERS. THESE PARTS INCLUDE TRANSMISSION CASES, VALVE BODIES, AND **CONVERTER HOUSINGS. OTHER MQL PROJECTS INCLUDE THE DEEP DRILLING OF CRANKSHAFT OIL BORES AND, IN THE FUTURE, THE MACHINING OF CYLINDER HEADS AND ENGINE BLOCKS.**

Overall pan of full MQL shop, showing multiple machining centers

FOR THESE SOPHISTICATED PARTS AND PROCESSES, NEAR-DRY MACHINING COULD NOT SIMPLY BE DROPPED INTO PLACE, BUT RATHER REQUIRED SEVERAL STEPS. BASED ON A 1998 PILOT PROGRAM IN EUROPE, FORD INTRODUCED ITS PILOT MQL PROGRAMS IN 2001, LEADING TO A FULL-SCALE IMPLEMENTATION IN 2005 OF 41 MACHINE TOOLS AT LIVONIA. ADDITIONAL MQL-ENABLED MACHINE TOOLS CONTINUE TO BE ADDED AT OTHER FORD FACILITIES IN NORTH AMERICA, BRINGING THE OVERALL TOTAL TO 135 MQL MACHINES IN 2007, AND NEARLY 200 MACHINES BY 2008 IN

	THE DETROIT AREA ALONE.
	THIS EXPANSION OF MQL INTO NEW PRODUCTION SHOWS THAT THE U.S. AUTOMAKER IS SERIOUS ABOUT UPGRADING ITS TRADITIONAL MANUFACTURING LINES WITH 21ST-CENTURY INNOVATIONS.
SCENE 54. Step by step overview of Ford line:	AS SHOWN HERE, THE CNC MACHINE TOOLS IN LIVONIA ARE LINKED IN FULLY AUTOMATED LINES FOR MACHINING TRANSMISSION CASES AND VALVE BODIES.
Articulated arm robot picks up transmission cases	ROBOTS ARE USED TO PLACE PARTS ON A CONVEYOR...
Overhead Gantry loading…	AND GANTRY AUTOMATION LOADS AND LOADS THEM INTO MACHINING CENTERS…
Inside machining center: chips flying…	THE MACHINE TOOLS CUT FEATURES AND DRILL HOLES INTO EACH WORKPIECE…
Internal of machining center showing MQL equipment sitting therein	USING LUBRICANT FROM MQL FEEDING EQUIPMENT MOUNTED INSIDE EACH MACHINE.
SCENE 55.	UNLIKE MQL SYSTEMS THAT USE EXTERNAL NOZZLES TO SPRAY LUBRICANT ONTO CUTTING SURFACES, FORD'S MQL EQUIPMENT FEEDS BOTH LUBRICANT AND AIR THROUGH THE TOOL SPINDLE AND CUTTING TOOL ITSELF. THE AIR AND OIL ARE MIXED INSIDE THE TOOLING AND EMITTED THROUGH HOLES STRATEGICALLY PLACED IN THE CUTTING TOOL, APPLYING JUST THE RIGHT AMOUNT OF AEROSOL MIXTURE TO THE CUTTING SURFACES.
09.04.15 - Bielomatik pan of cross-section of cut-away two-channel system from right to left	

A THIN LAYER OF OIL AT THE CUTTING INTERFACE LUBRICATES THE SURFACES EFFECTIVELY -- JUST AS ON AN AUTOMOBILE ROADWAY, WHERE ONLY A THIN LAYER OF WATER OR ICE IS ENOUGH TO MAKE THE SURFACE EXTREMELY SLIPPERY.

Any non-MQL footage?

TRADITIONAL FLOOD COOLING DOES A GOOD JOB OF EFFECTIVELY STABILIZING THE TEMPERATURE OF THE WORKPIECE AND CUTTING TOOL, BUT FLOOD-COOLANT HANDLING CREATES EXTRA OPERATIONAL BURDENS AND COSTS, AS FORD HAS FOUND IN ITS NON-MQL MACHINING OPERATIONS.

Vacuum system exterior on side on machining center showing small chip bin

UNLIKE WET-MACHINING OPERATIONS THAT USE FLOOD COOLANT TO HELP TRANSPORT CHIPS OUT OF THE MACHINE, NEAR-DRY MACHINING SYSTEMS MUST REMOVE CHIPS FROM THE MACHINE WITH A VACUUM SYSTEM OR SOME OTHER MEANS. BUT MQL CHIPS, HAVING THE CONSISTENCY OF UNCOOKED RICE, **FEEL** DRY AND ARE **BASICALLY** UNCONTAMINATED BY **OIL.**

Stoll reaching in and dropping handful of dry chips

SCENE 56.

Large chip-handling bin system

FURNESS, VO:
[VO:]The fluid contamination on the chips makes it more of a challenge for re-use or disposal of the metal working chips themselves after cutting has occurred. Moving to MQL machining is a means to eliminate these costs and environmental burdens associated with wet machining.

SCENE 57.

Prev. scene cont'd

NARRATION (VO):

NEAR-DRY MACHINING HAS ALSO ALLOWED FORD TO CREATE AN OVERALL "GREENER" PLANT ENVIRONMENT. IT IMPROVES NOT ONLY CLEANLINESS AND AIR

QUALITY, BUT PLANT WORKER MORALE, SAYS FORD'S ALEXANDER STOLL.

SCENE 58.
CGS: Alexander Stoll

Technical Expert

Advanced Manufacturing Technology Development, Powertrain

Ford Motor Company

STOLL, ON CAMERA :
Ford wants to be a leader in green manufacturing technology. We feel being responsible for the environment inside of a plant and certainly outside of a plant, and we see the potential to minimize hazards that people have to deal with. In running manufacturing you need to make sure that people work in a safe environment, that you treat coolant fluids in the right way, that you run machines in an appropriate manner.

SCENE 59.

Machining of transmission case

NARRATION (VO):

BUT SUCCESSFUL IMPLEMENTATION REQUIRED MAKING DIFFICULT CHOICES ABOUT TECHNOLOGY – CHOICES THAT CONSIDER ALL FACTORS THAT WILL AFFECT THE PROCESS.

SCENE 60.

CGS: Stoll will email graphic for this he says

STOLL, vo:
[VO:]With regards to the overall MQL application, it is very important to regard the entire system. You need to focus on all contributing elements.

SCENE 61.

09.07.00 – 25 Pan of Bielomatik delivery unit (tubes and wires) at Bielomatik

MT has 2 graphics from Bielomatik that help clarify diffs. btw one- and two-channel

NARRATION (VO):

THE KEY TO THE TYPE OF MQL USED **BY FORD-POWERTRAIN** IS A SYSTEM THAT MIXES SMALL AMOUNTS OF OIL AND AIR **AT THE TOOL CONNECTION POINT** AND DELIVERS THIS AEROSOL THROUGH THE TOOLING TO THE CUTTING ZONE.

TWO KINDS OF "THROUGH-THE-TOOL" SYSTEMS ARE COMMERCIALLY AVAILABLE, COMMONLY CALLED "ONE-CHANNEL" AND "TWO-CHANNEL" SYSTEMS. ONE-

CHANNEL SYSTEMS MIX THE OIL AND AIR UPSTREAM BEFORE SENDING THE MIXTURE THROUGH THE MACHINE TOOL SPINDLE AND CUTTING TOOL – A DISTANCE OF UP TO 20 METERS.

09.04.15 - 40 Close-ups and pan of Bielomatik sectioned mock-up

TWO-CHANNEL SYSTEMS DELAY MIXING THE INDIVIDUAL AIR AND OIL STREAMS UNTIL THEY REACH THE CUTTING TOOL ITSELF. THE FLUID MECHANICS ARE COMPLEX, BUT IN SHORT, THE PASSAGES DIRECT OIL INTO THE AIR STREAM THROUGH A "LANCE" COMPONENT. THE RESULTING COOLANT MIXTURE THEN GOES THROUGH THE CUTTING TOOL TO OUTLET HOLES NEAR THE CUTTING EDGES.

SCENE 62.

Stoll or

Could use graphics' details or mock-up footage here again

STOLL, ON CAMERA/VO :
The MQL supply system we are using is a two-channel system. This two channel system has a rotary transmission and a quick **VALVE (SAID?)**, plus a lance that is connected to the rotary transmission. Oil drops are being shot through the lance into the tool connection point, while at the same time air is running independently around the lance. So air and oil gets mixed inside the tool connection point, and the tool connection point sits inside the tool holder. We try to mix air and oil as close as possible toward the cutting edge.

SCENE 63.

Prev. scene cont'd

NARRATION (VO):

THIS TOOLING DESIGN MUST PREVENT OIL/AIR SEGREGATION CAUSED BY THE CENTRIFUGAL FORCES IN THE SPINNING TOOL **–** A **CHALLENGE** WITH ONE-CHANNEL MQL.

TO BE EFFECTIVE FOR PRODUCTION, THE SYSTEM

MUST ALSO DELIVER THE **AEROSOL MIXTURE** QUICKLY -- WITH A RESPONSE TIME OF 0.1 TO 0.2 SECONDS.

FORD USES TWO-CHANNEL MQL SYSTEMS FROM BIELOMATIK ["BEEL-O-MATIK"] INCORPORATED. THE COMPANIES' PARTNERSHIP TO DEVELOP THE SYSTEM BEGAN IN THE LATE 1990'S, AND ITS DEVELOPMENT REQUIRED SEVERAL STEPS.

SCENE 64.

Stoll

STOLL, ON CAMERA :
The goal was to make this system, to make the MQL supply system, robust, to develop FMEAs, instructions, training material, for our people, but to also debug that system, to basically lift it from a laboratory test stand, or from laboratory equipment, into mass production equipment that can run three shifts a day, 24 hours, 7 days a week.

SCENE 65.

Machining center machining trans case – tool close up

NARRATION (VO):

CUTTING TOOLS HAD TO BE DESIGNED SPECIFICALLY TO FIT THE MQL DELIVERY SYSTEM.

SCENE 66.

Prev. scene cont'd

STOLL, VO:

[VO:]Now talking about tooling, talking about MQL supply to the cutting edge, it is important to optimally design the cutting tool. You have to do a certain up-front engineering, probably more up-front engineering at this time than you used to do for wet tooling, because you don't have the high pressure coolant pumps any more.

SCENE 67.

09.04.40 – close up of cutting tool in mock-up at Bielomatik

NARRATION (VO):.

CUTTING TOOLS MUST HAVE THE RIGHT INTERNAL DESIGN GEOMETRY FOR MQL. UNLIKE WITH THROUGH-THE-TOOL "WET" MACHINING, TOOLS FOR MQL REQUIRE OUTLETS THAT DISTRIBUTE OIL EVENLY IN

DIFFERENT RADIAL DIRECTIONS. THE DESIGN AND PLACEMENT OF THESE OUTLETS IS CRITICAL FOR MQL.

SCENE 68.

Stoll

STOLL, ON CAMERA :

Quite often people make the mistake in distributing outlets always the same diameters. Basically you have to focus on the 'water hose' effect and make sure that not all the oil or all the minimum quantity lube comes out of one hole.

SCENE 69.

Machining in trans case cell that emphasizes larger-diameter reamers if possible

NARRATION (VO):.

TO UNDERSTAND THE WAY MQL FLUID WILL EXIT A CUTTING TOOL, DEVELOPERS **SHOULD** RUN SPRAY PATTERN TESTS FOR EVERY NEW TOOL DESIGN. THIS ALOWS ENGINEERS TO "GET A FEEL" FOR HOW FLUID IS DISTRIBUTED BY THE TOOL, AND FOR HOW MUCH OIL IS NEEDED. THE SPRAY PATTERN OF LARGE-DIAMETER OR MULTI-EDGED TOOLS MAY BE PARTICULARLY DIFFICULT TO PREDICT IN ADVANCE.

THE TEST SHOULD BE RUN AT THE SAME RPMS AS IN PRODUCTION, ON SIMILAR MACHINES, FLUID, AND EQUIPMENT.

SCENE 70.

Stoll

STOLL, ON CAMERA :

Running a spray pattern test, you may not necessarily do a high scientific approach, but you get a feel if a tool is properly designed, and you get a feeling if a tool will work and function later on in production. You also will find out if there is further optimization work necessary with regard to response time or with regard to equal distribution of the oil.

SCENE 71.

NARRATION (VO):.

Continue scene previous to previous scene	BUT GETTING AN ADEQUATE OIL DISPERSION MAY BE ESPECIALLY CHALLENGING FOR SOME METAL-CUTTING SITUATIONS – OR ALMOST IMPOSSIBLE.
SCENE 72.	**FURNESS, ON CAMERA and VO :**
Furness	Some of the other operations where it may be a challenge to use MQL would be in large diameter tools, where the fluid needs to be distributed to many different ports on a tool, with a range of diameters on the tool. If this tool is also going deep into bores in a particular component, there may be a challenge to support the cutting, and then there is the associated challenge when you're using tools like that for the chip management. So I think in general, if there is ability to pass the fluid through the tool, it can work. You just need to consider the ability of the machine and the tool to distribute the fluid to where it needs to go.
Back to machining footage	
SCENE 73.	**NARRATION (VO):**.
Prev machining footage cont'd	THROUGH-THE-TOOL MQL IS STILL A RELATIVELY RECENT AND NON-STANDARDIZED TECHNOLOGY – AND ONE THAT REQUIRES MUCH PRE-PLANNING AND ENGINEERING BEFORE IT CAN BE IMPLEMENTED. FOR OPTIMAL MQL, DEVELOPERS CANNOT JUST "COPY AND PASTE" TRADITIONAL COOLANT EQUIPMENT INTO THEIR PROCESSES.
SCENE 74.	**STOLL, ON CAMERA :**
Stoll	Since it is still a pretty young technology, not every laboratory, not every supplier partner, or not every customer does have appropriate test equipment yet. The fault that is being done way too often is to one-on-one copy/paste wet equipment, or just use a wet machine or a wet cutting tool, feed it with some oil drops, and declare it as an MQL tool or an MQL process.

SCENE 75.	**NARRATION (VO):**.
Trans. cases being conveyed down the line	BOTH STOLL AND FURNESS EMPHASIZE THAT ONLY GOOD, SOLID RESULTS FROM REAL-WORLD NEAR-DRY APPLICATIONS WILL DRIVE MORE ADVANCEMENTS IN MQL SYSTEMS. AND FORD HAS INDEED REALIZED MULTIPLE POSITIVE OUTCOMES FROM ITS IMPLEMENTATION. REDUCED FLUID USAGE, HANDLING, AND DISPOSAL HAVE ALL SAVED THE COMPANY MONEY.
Large chip-handling bin system	IN FLUID HANDLING, AN INDIRECT BUT MAJOR COST SAVINGS HAS BEEN FROM THE ELIMINATION OF FILTER MEDIA MATERIAL THAT THAT WAS ONCE NEEDED FOR SCREENING OUT CHIP PARTICLES FROM SPENT FLOOD COOLANT. NEARLY 3,000 METERS PER YEAR OF THIS 2-METER-WIDE MATERIAL HAS BEEN SAVED WITH MQL IN LIVONIA.
Dirty filter media footage?	
Alt. angle of chip bin on side of machining center	AND ALTHOUGH CHIPS NOW REQUIRE SPECIAL ATTENTION FOR REMOVING THEM FROM THE MACHINE TOOL, THE RECOVERED CHIPS ARE MORE VALUABLE FOR RECYCLING, BECAUSE THEY ARE NOT CONTAMINATED WITH COOLANT. MOREOVER, THE MQL CHIP-HANDLING SYSTEM HAS ALSO SIGNIFICANTLY IMPROVED THE AIR QUALITY AROUND THE MACHINES, REDUCING THE NUMBER OF PARTICLES POTENTIALLY BREATHED IN BY OPERATORS.

SCENE 76.	**FURNESS, OC:**
Furness	Chip handling is one of the significant concerns we had to address with the elimination of coolants, and a significant portion of our research and development attention was directed toward this particular open issue. Obviously, with the elimination of the flood of coolant from the machine, getting rid of chips from the interior of the machine or fixture is a challenge. We have addressed this by appropriate attention to the fixture, the interior of the machine to direct chips into the bed, and we are currently using a vacuum method to extract the chips from the work envelope.
SCENE 77.	**NARRATION (VO):**
Machining center footage	INITIALLY, FORD WAS ALSO WORRIED THAT FEEDS & SPEEDS MIGHT BE REDUCED WITH MQL.
SCENE 78.	**FURNESS, ON CAMERA :**
Furness	When we began our development, the objective was to minimize or eliminate the use of fluids without any detrimental impact on process productivity. So we set that as our baseline expectation. We have been pleased to see that we have been able to realize that objective, and in many cases we have been able to surpass the feeds and speeds that are being used in wet machining. This is, in some sense, counterintuitive, but our production experience and laboratory developments validate this behavior.
SCENE 79.	**NARRATION (VO):**.
09.16.00 – close ups of valve bodies on table	MOREOVER, PART QUALITY HAS BEEN MAINTAINED, AND EVEN IMPROVED IN SOME OF THE HOLE-MAKING OPERATIONS USING MQL. MAINTAINING PART QUALITY IS COMPLICATED BY THE FACT THAT MQL CREATES MORE THERMAL EXPANSION IN THE WORKPIECE AND TOOLING THAN FLOOD

COOLING. THIS EXPANSION, MONITORED BY IN-PROCESS TEMPERATURE SENSORS, **CAN BE COMPENSATED FOR IN THE CNC PROGRAMMING.**

BUT MQL DOES CIRCUMVENT QUALITY PROBLEMS SEEN IN FLOOD-COOLING WITH WATER-OIL EMULSIONS, FOR A VERY BASIC REASON...

SCENE 80.

Prev. scene cont'd

FURNESS, VO:

[VO:] We attribute this to the greater lubricity that is provided from the MQL oil compared to an emulsion. We also attribute it to the fact that each time you're doing a cutting operation you're using new fluid. It's not reused. In the past we have seen that our quality begins to degrade over time as a coolant system ages. As the coolant begins to gain small level contaminants over time that aren't captured through the filtration system, that has in certain cases impacted quality.

SCENE 81.

Background footage:?

NARRATION (VO):.

THE OVERALL COST SAVINGS AND INVESTMENT PAY-OFF PERIOD OF MQL EQUIPMENT ARE DIFFICULT TO MEASURE. ONE WAY TO MEASURE SUCCESS IS TO CALCULATE COSTS SAVINGS OVER A CERTAIN PERIOD OF TIME FOR A CERTAIN PART AND PROCESS. FOR EXAMPLE, FORD HAS ESTIMATED COST REDUCTIONS OVER 10 YEARS FOR A SELECTED POWERTRAIN COMPONENT. THE MQL SAVINGS ARE ESTIMATED TO BE AROUND 17%, COMPARED WITH WET MACHINING. THESE SAVINGS COME FROM SEVERAL FACTORS, INCLUDING…

CGS: 10-Year Life Cycle Cost Comparison for Powertrain Component Machining

	Wet Machining	MQL
Acquisition Costs	82.5%	73.7%
Downtime Costs	1.3%	0.2%
Maintenance Costs	4.6%	1.9%
Operating Costs	9.3%	6.3%
Floorspace Costs	2.3%	0.8%
TOTAL	100.0%	82.9%

REDUCED **OVERALL** EQUIPMENT ACQUISITION COSTS…

REDUCED DOWNTIME…

REDUCED MAINTENANCE…

LOWER OPERATING COSTS, DUE TO LESS ENERGY CONSUMPTION…

AND REDUCED FLOORSPACE REQUIREMENTS.

IN ADDITION, SAFETY, A DIFFICULT FACTOR TO QUANTIFY, HAS BEEN IMPROVED.

SCENE 82.

FURNESS, ON CAMERA :

Furness

It is important to note that the cost reduction includes many different factors. There is the investment element of the machinery, the ongoing operating costs of the equipment, as well as the maintenance actions associated with the machinery during its life. So up front there is significant reduction in the investment associated with the high volume coolant systems that are typically used to support wet machining. That cost isn't completely eliminated, it's replaced by investment to handle the chips that are machined dry, but the delta is quite significant.

SCENE 83.

NARRATION (VO):.

Overall shots of conveyor line

FORD HAS ALSO LEARNED SEVERAL LESSONS THAT WILL ENABLE IT TO INTRODUCE MQL MORE EASILY IN FUTURE PROCESSES. ONE LESSON IS THAT ADDING MQL TO CURRENT, TRADITIONAL PROCESSES IS NOT ALWAYS JUSTIFIABLE IN TERMS OF COST. THUS, FORD IS FOCUSING ON MAKING NEW PRODUCTION LINES NEAR-DRY, RATHER UPGRADING ITS EXISTING, "LEGACY" PRODUCTION SYSTEMS LIKE TRANSFER LINES.

SCENE 84.

FURNESS, ON CAMERA :

Furness	We implemented the MQL technology in conjunction with a shift to using CNC machines as our machining strategy for powertrain components. Our legacy systems in place are almost exclusively transfer line systems, and the application of the MQL technology is not necessarily straightforward for a transfer line system, and the cost savings to be realized by introducing MQL into a transfer line production system probably aren't always justified.
SCENE 85.	**NARRATION (VO):**.
Valve bodies in queue on conveyor line	ANOTHER LESSON IS THAT THE BEST MQL SYSTEM FOR A LARGE OPERATION LIKE FORD'S MAY NOT BE THE BEST CHOICE FOR A SMALL MACHINING OPERATION. FORD'S FOCUS IS ON SPEED AND PRODUCTION RELIABILITY, SINCE PART CHANGEOVERS ARE RELATIVELY INFREQUENT. BUT A JOB SHOP NEEDS FLEXIBILITY IN ITS MQL SYSTEM TO ADJUST TO VARYING CUSTOMER REQUIREMENTS FOR DIFFERENT PARTS.
SCENE 86.	**FURNESS, ON CAMERA :**
Furness	Although our systems are flexible to accommodate different types of transmission cases or valve bodies or cylinder heads, we are very different than a job shop in the sense that we're not retooling the machine on a weekly, daily or monthly basis. When this technology is applied in a job shop environment, I would expect that the requirements on the technology are not as rigid, because they have more production changeover and they're able to accommodate operating variations in the MQL technology that we cannot tolerate in high volume production.
SCENE 87.	**NARRATION (VO):**.
Scene previous to previous cont'd	STILL, EVEN THOUGH ITS OPERATIONS ARE LARGE-

SCALE, FORD IS SEEKING GREATER FLEXIBILITY IN ITS FUTURE APPLICATIONS OF MQL, LOWER COSTS FROM USING MORE STANDARDIZED MQL EQUIPMENT, AND A "LEANER" APPROACH TO MQL OVERALL THAT REDUCES NON-VALUE-ADDED OPERATIONS.

SCENE 88.

Stoll

STOLL, ON CAMERA :
So the future trend is going to be the green factory approach, keeping flexibility up, or even improve flexibility; to respond to potentially changing customer demands on short notice, and also to ensure and support manufacturing with as few machine tools as possible, so we will push toward high productivity.

SCENE 89.

Any footage of crankshafts or their machining?

NARRATION (VO):.

FORD HAS LEARNED ENOUGH ABOUT THE ADVANTAGES OF MQL TO INCORPORATE NEAR-DRY MACHINING FOR OTHER POWERTRAIN COMPONENT LINES – SUCH AS ALUMINUM ENGINE COMPONENTS FOR FUTURE CAR PROGRAMS, AND EVEN FOR SOME FERROUS PARTS. STEEL AND IRON PARTS CAN OFTEN BE MACHINED WITH COMPLETELY 'DRY' HIGH-SPEED MACHINING, MAKING MQL IRRELEVANT. BUT CRANKSHAFTS, FOR EXAMPLE, CURRENTLY REQUIRE SOME MACHINING PROCESSES THAT BECOME DRAMATICALLY FASTER WHEN REPLACED WITH NEAR-DRY.

SCENE 90.

Furness

FURNESS, ON CAMERA :

Perhaps the biggest surprise has been in the application of the technology for deep hole drilling in ferrous parts, such as steel or iron crankshafts. The conventional process technology is gun drilling with high pressure fluids, and compared to what we have been able to achieve in MQL machining with twist drills, that process is four to five times slower. It's a remarkable improvement in productivity

for those operations.

SCENE 91.

NARRATION (VO):

Previous Ford footage cont'd

WITH MORE APPLICATIONS LIKE THIS ACROSS THE INDUSTRY, **ALEXANDER** STOLL FEELS THAT NEAR-DRY MACHINING WILL GRADUALLY INCREASE FROM A SINGLE-DIGIT PERCENTAGE OF ALL MACHINING PROCESS TO 25 PERCENT OR MORE IN THE NEXT 10 OR 20 YEARS.

SCENE 92.

STOLL, ON CAMERA AND VO:

Stoll

In a nutshell I feel it is in a kind of breakthrough mode, and at this point, with several mass scale production programs in place, where people can learn and improve things, where lessons learned are available, a good baseline has been established to further spread this technology.

09.04.15 - 40 Close-ups and pan of Bielomatik sectioned mock-up

[VO:] But it is a long process, and it requires a lot of people awareness. It requires up-front engineering, and it requires a more thorough thinking about tools, processes, certain conditions and relationships of machine tool and elements, the environment, cutting tooling, etc.

SCENE 93.

FURNESS, ON CAMERA AND/OR THEN VO :

Furness

I foresee that in the future this will, at some point, overtake wet machining as the solution of choice. But at this point it's just beginning. The momentum is building, and we are trying to be behind this wave and push it. As I stated before, this is the strategy for our company going forward, but we need to have the support system in place to enable us to do this. That includes all of our suppliers for the cutting tool systems, the machining equipment, the chip handling systems. The market needs to be desirable for them so they can compete. Obviously we know this is an advantage for us and we need to drive it more into widespread use so we can take further advantage of it.

Any Ford footage of automated line showing multiple things

-- FADE TO BLACK --

SCENE 94.

NARRATION (VO):

Unist machining footage

IN THIS PROGRAM, WE HAVE SEEN THAT NEAR-DRY METHODS CAN BE USED IN SEVERAL METALWORKING SITUATIONS THAT WOULD NORMALLY REQUIRE LARGE AMOUNTS OF COOLANTS AND LUBRICANTS.

SCENE 95.

NARRATION (VO):

pan of roll-forming line 04.27.35 – 28.00 – show guy packing long parts at end of line

IN SHEETMETAL FORMING AND PUNCHING, MQL SYSTEMS APPLY ONLY THE THIN LAYER OF LUBRICATION THAT IS REQUIRED. THE RESULTING PARTS DON'T NEED TO BE CLEANED OF EXCESS OIL BEFORE PACKING, AND THE OPERATORS ARE EXPOSED TO FEWER WORKPLACE HAZARDS…

01.17.00 – 17.10 PB of guy holding bar, sawing at machine

SIMILARLY, FOR METAL SAWING, INTEGRATED MQL SYSTEMS REDUCE CONTAMINATION IN THE SHOP AND EXTEND SAW-BLADE LIFE —- ADVANTAGES THAT OUTWEIGH THE ADDITIONAL EQUIPMENT COSTS FOR MQL…

Any cool machining at Advanced Mold

FOR MACHINING FEATURES IN HARDENED STEEL MOLDS, NEAR-DRY PROCESSING HAS INCREASED CUTTING TOOL LIFE AND SPEEDS...

Shot of clean aisles etc. at Ford

AND IN LARGE-SCALE AUTOMOTIVE MACHINING OPERATIONS AT FORD, MQL KEEPS BOTH THE FACTORY AND THE CHIPS CLEAN -- HELPING TO REDUCE OVERHEAD AND MAJOR COST BURDENS IN THIS HIGHLY COMPETITIVE MANUFACTURING SECTOR.

SCENE 96.

VARIOUS short SCENES AT COMPANIES FROM INTRO

NARRATION (VO):

THUS, MQL AND NEAR-DRY MACHINING, IN THEIR MANY FORMS, OFFER IMMEDIATE AND VISIBLE BENEFITS. BUT MUCH PLANNING MAY BE REQUIRED BEFORE INTRODUCING MQL, AND SIGNIFICANT CHANGES MAY BE NEEDED IN A SHOP'S CULTURE.

IN OTHER WORDS, THE ATTITUDE OF "THE MORE COOLANT, THE BETTER" HAS NO PLACE IN A NEAR-DRY MQL ENVIRONMENT!

--- FADE TO BLACK ---

SCENE 97.

Manufacturing Insights wishes to thank the following contributors for their assistance in the production of this program:

Produced By:
The Society Of Manufacturing Engineers

Written By:
Michael Tolinski,
MText Technical Editing