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HVAF Thermal Spray for increased life in cutting pumps

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Application/Problem

Bio-gas manufacturing

Wear parts in cutting pumps

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Together with Ragn-Sell Helgestorp AB, biogas manufacturer.
-try out techniques and products to reduce wear and costs of wear parts for cutting pumps, improve cutting of the incoming materials , reduce problems in subsequent processing equipment due to poor cutting and provide better digestion yield of digestible mass in medium.

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Test object

Knifes for 2-4 cutting centrefugal pumps, originally made by Landia type MPTK 105

Motor power 18,5 kW , 1470 rpm, with a flow of 300 m3/h at 5 m back pressure.

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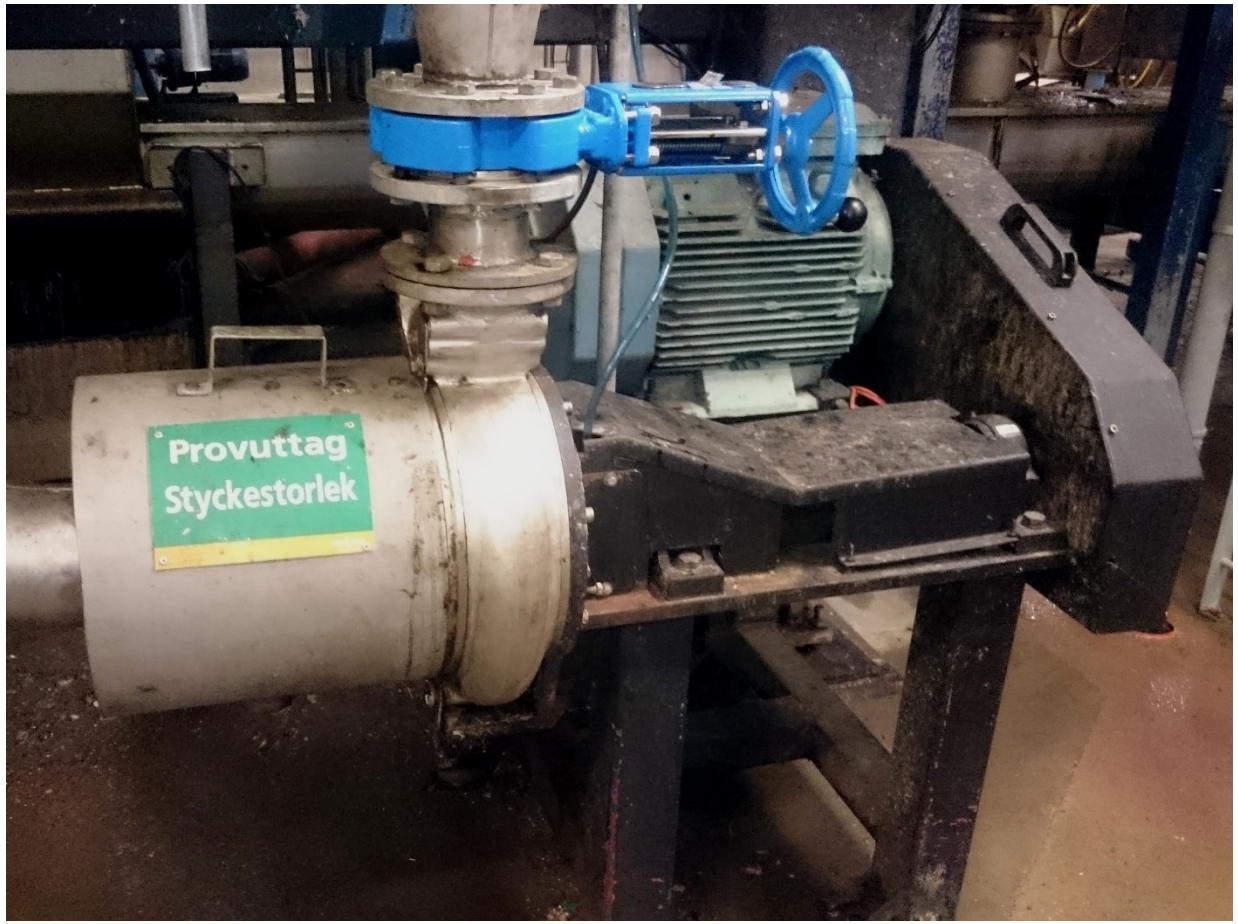
The pumps are already modifyed by MSI Teknik AB, since they in their original design exibited frequent failiures, mainly due to failure of shaft seal.



Pumped media was then, when seal failed, coming into the electrical motor.
The pumps now have double shaft seals and the motor separated from the pump with a belt drive.

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The Problem

Worth knowing about household waste

The material in digestible garbage has all possible features, such as hard and soft material types , plastic, gravel / stone, glass , non- magnetic metal , can have a low pH and may cause fibers to tangle up like lianas in a pump . Material is highly abrasive and has corrosive properties. The medium is pumped by the addition of process water normally in a Dry substance content of 7-9 % and in the first process step has a particle size up to about 20-30 mm . The pump capacity measured in tons

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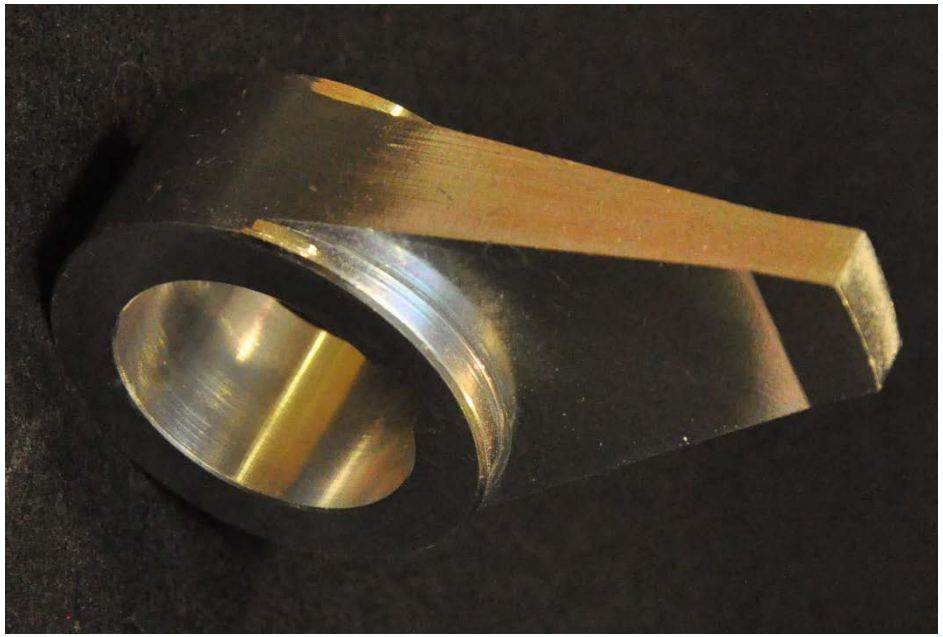
The pump has two rotating knives and three fixed knives . Life expectancy in this application is very short. Typically one to two weeks before wear causes stops and impaired digestion in the process and they must be replaced .



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Abrasion and corrosion damage to the knifes becomes after only 1-2 weeks so extensive that they simply do not properly cut the medium and this causes different problems and process downtime.

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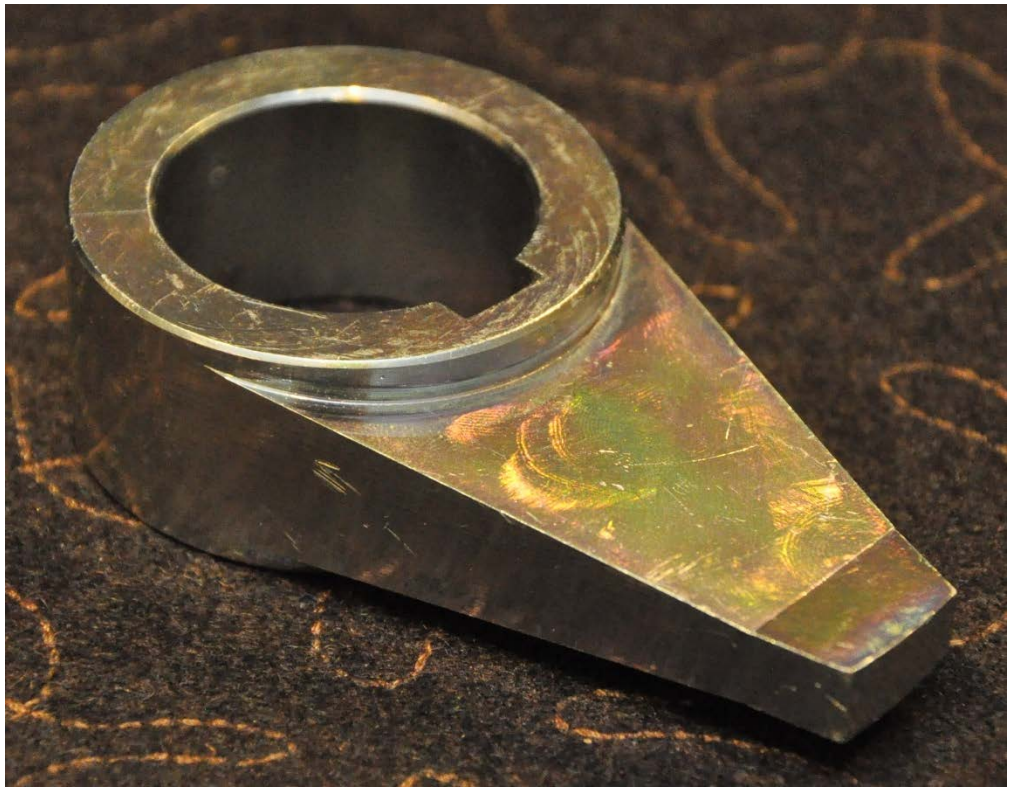
Original/stock knives are made of surface hardened steel and then they are hard chromed for a surface hardness of about 900 Vickers. As the wear is breaking through the hardened layer into the softer steel they then wear down very fast.



Attempts had been made previously where the whole knife was made of Hardox 500 with a hardness of about 50 HRC. This is a little softer than the original knife but because hardness is the same throughout these had the same lifespan as the original

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The solution - Thermal Spray

The solution we proposed to the problem was to coat the knifes with a layer of thermally sprayed WC Co Cr and to do this on knives, locally manufactured by MSI Teknik AB , in the material Hardox. Thermal Spray process: Uniquecoat HVAF M3

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Thermal spraying is a coating process which in this case has a combustion process (Propane and Air) that provides a combustion flame with a very high speed. In this flame the material (powder) is introduced. The material is softened by the heat, accelerated to a very high velocity and then hits the surface to be sprayed where the powder particles flattens out and forms a layer

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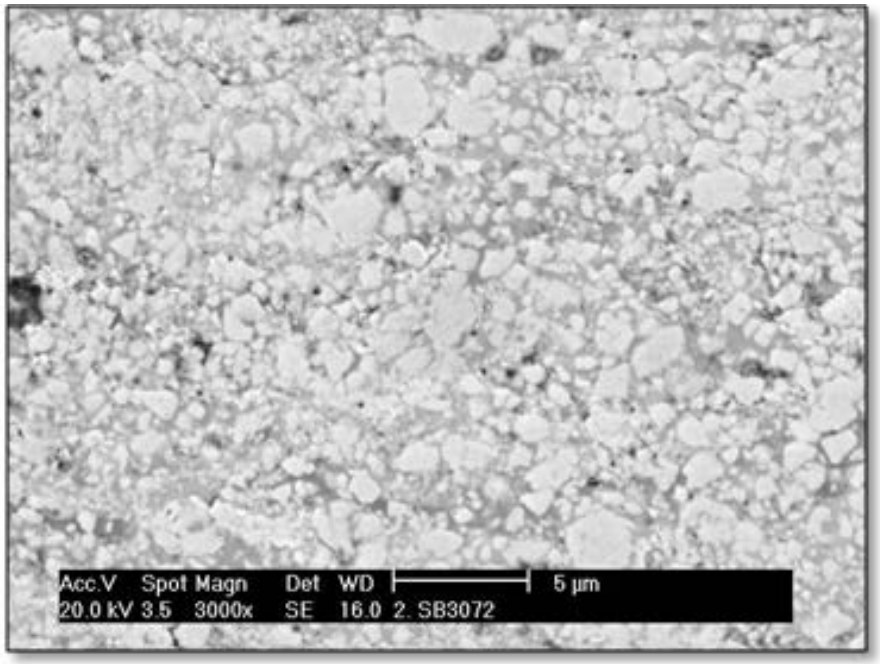
The material in this case is a so called " Cermet " ceramic - metal . Ceramic particles , in this case, tungsten carbides and metallic particles , cobalt and chromium , which acts matrix and allows for the hard ceramic particles to be embedded in the metal matrix and stick to the surface . The thickness of the thermally sprayed layer in this application is 0.2-0.25 mm , hardness 1300-1500 Vickers
Powder HC.Stark Amperit



M3

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The material, WC Co Cr, is fairly expensive, in this case about $80/kg ,

It is therefore very important to ensure that the spraying is actually onto the part (knifes) as much as possible and not in the "air". To maximize the efficiency of the spray process for this specific application we developed a set of special fixtures for the various sides of the knifes to be coated where we maximized the exposed “surface of knife” and minimized spraying in the air

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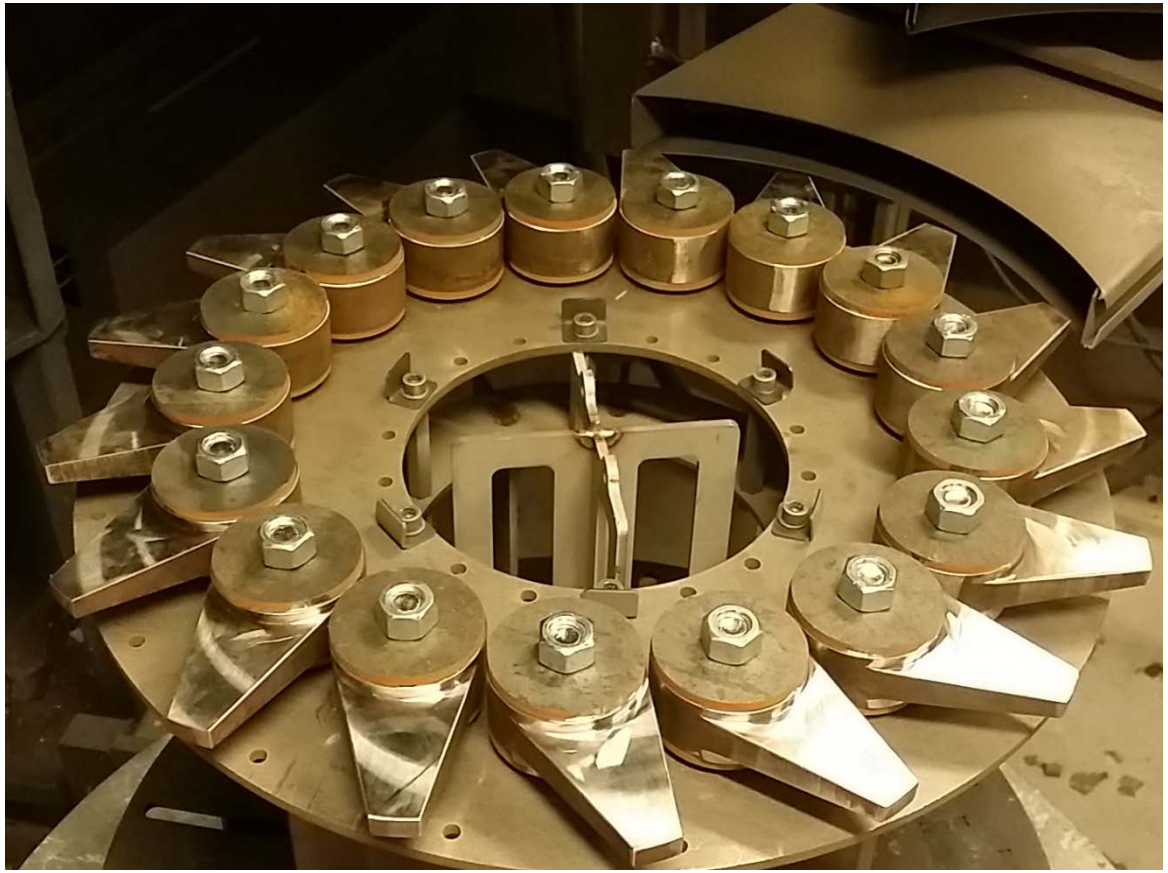
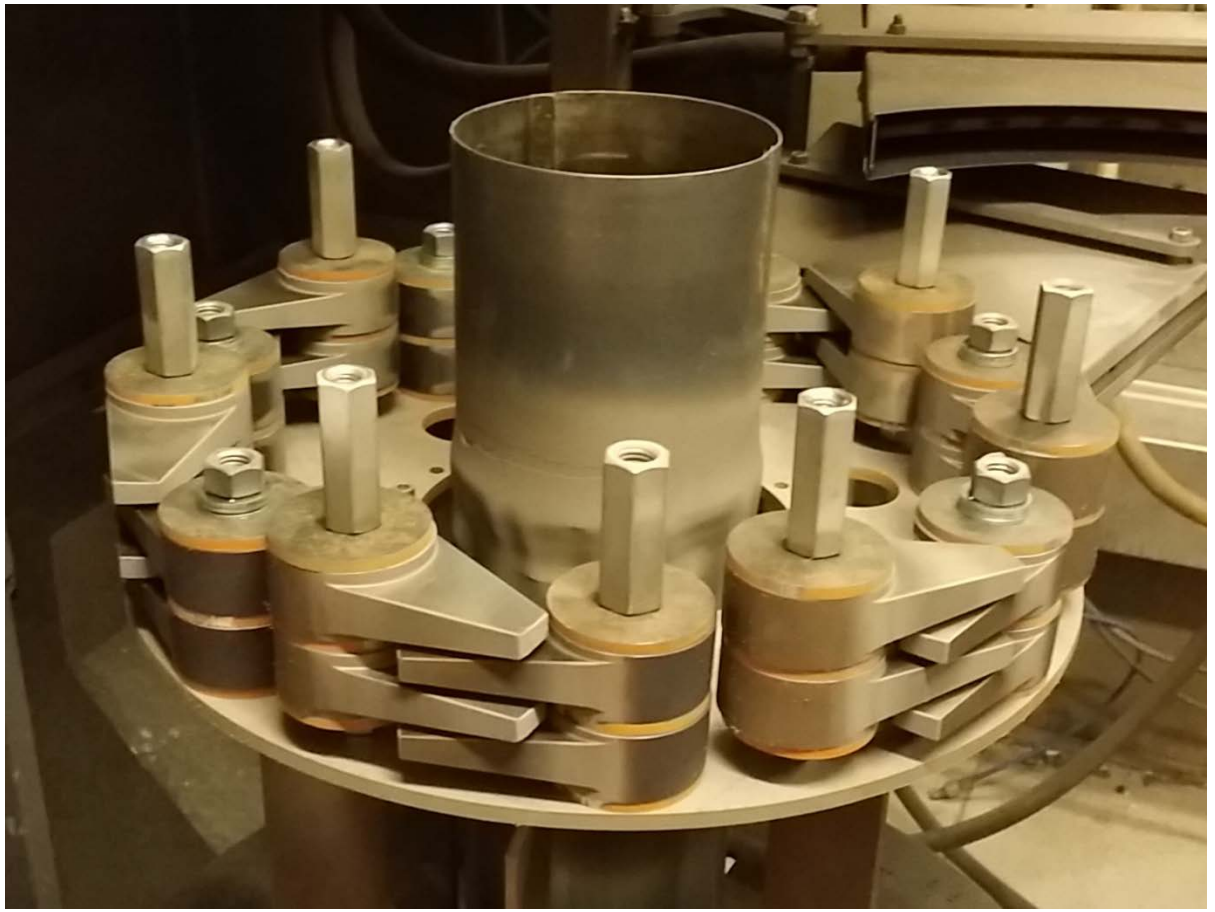
Tips and back side of rotating knife





Cutting side of rotating knife

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Sides of rotating knife

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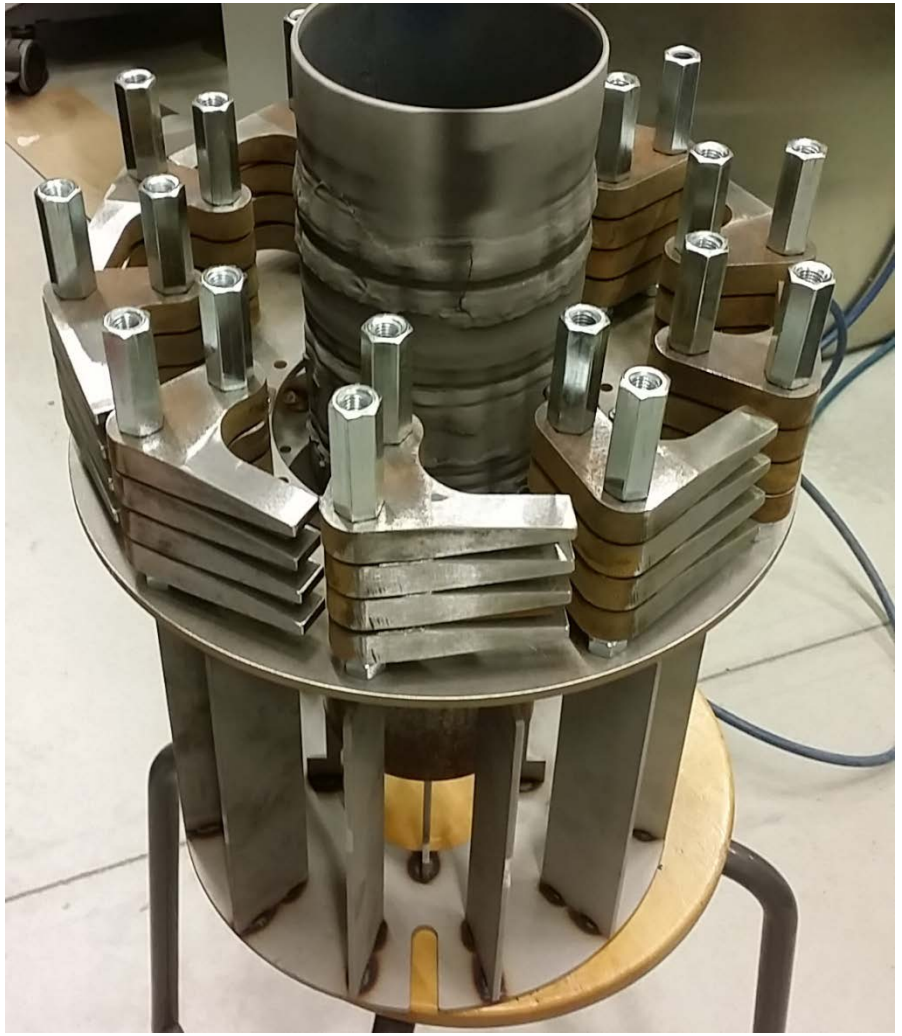
Tips and sides of the fixed knifes



Cutting side of the fixed knife

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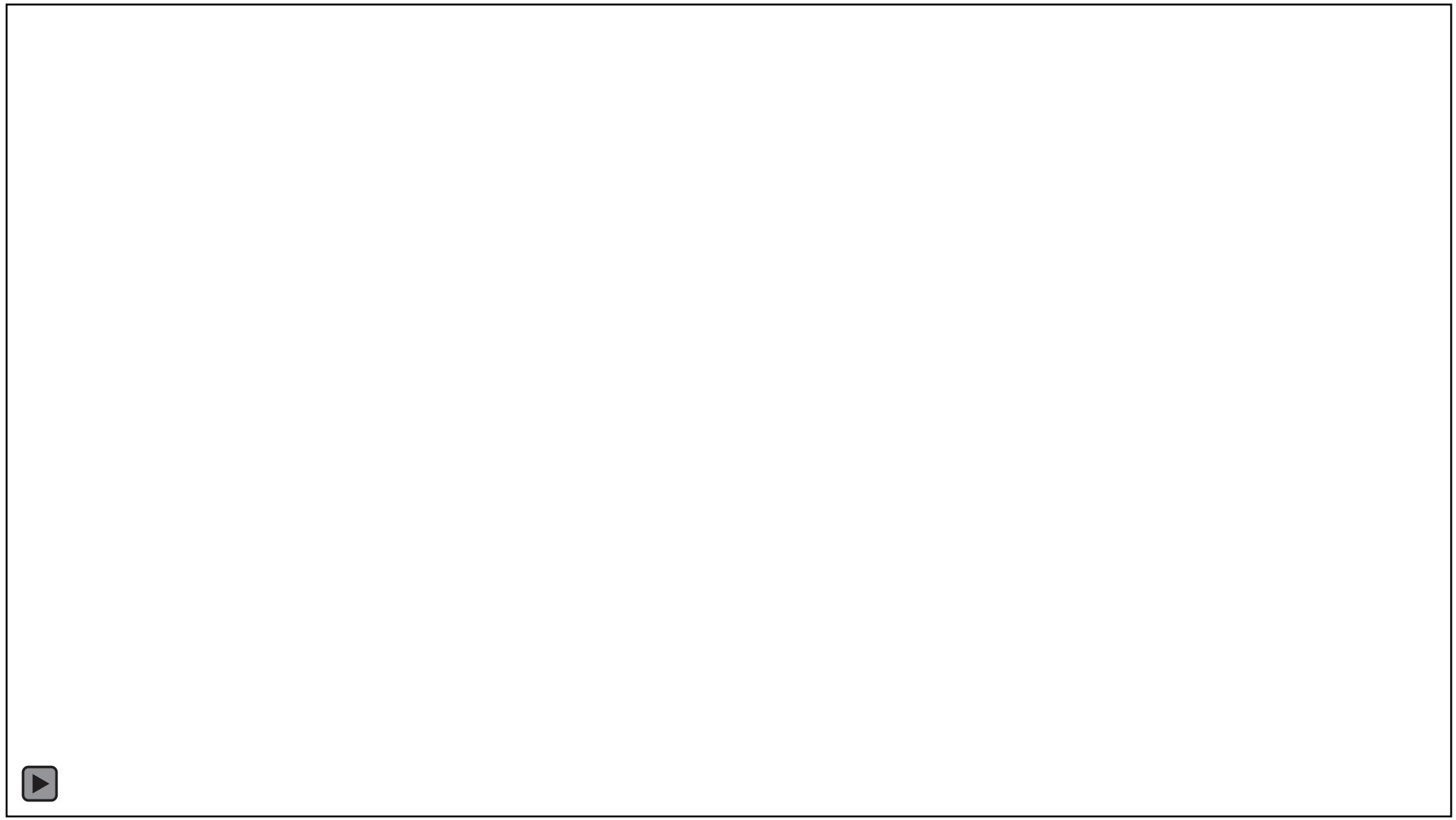

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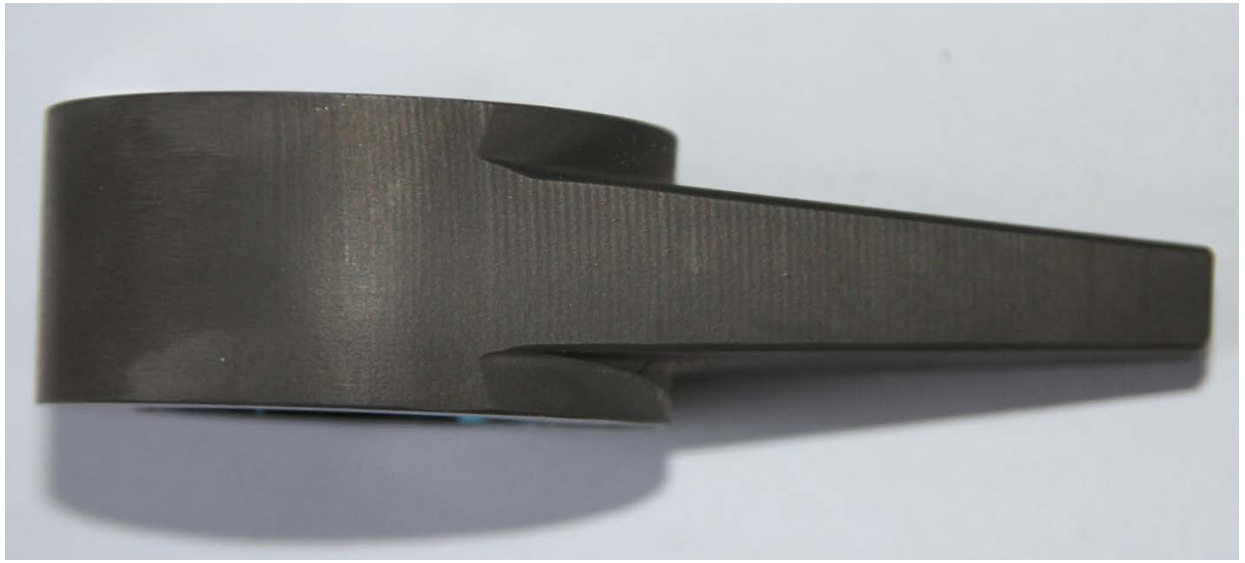

Sprayed knifes

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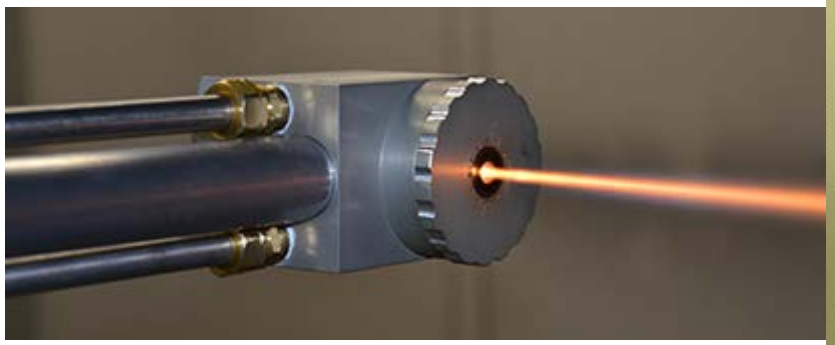
The spray gun Uniquecoat HVAF M3 is large and the process of thermal spraying is a “line of sight process” where you can only coat surfaces that the gun can access. A miniaturized version is now designed so that you can , for example, spray the inside of the pump housing with the same technology .



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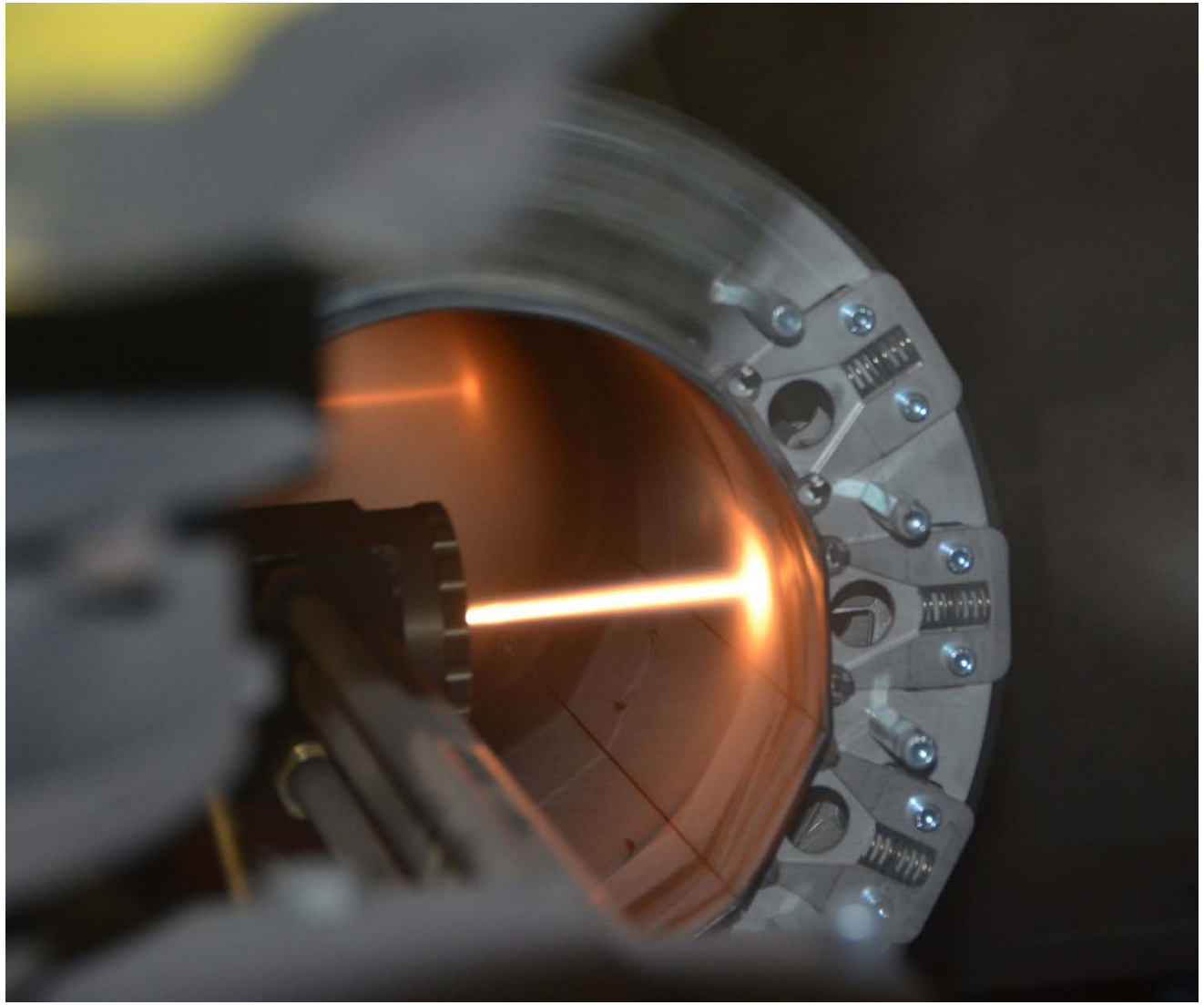

This new HVAF gun for internal diameters can spray in cavities/bores/tubes with small diameters down to 70 mm. -Still with the same quality of coating with a hardness of 1300 Vickers

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Result

Coated knife and original knife after 1-2 week operation, the original knife is scrapped and the coated knife is totally intact.

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Coated knife and original knife after 1-2 week operation

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Original knife after 1-2 week operation and Coated knife after 8 weeks of operation. The coated knife shows wear at the tip and has a small chip at the edge

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Original knife after 1-2 week operation and Coated knife after 8 weeks of operation. Original knife scrapped and the coated knife shows wear at the tip and has a chipped edge

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- The cost of the new knife is 1.7 times the cost of the original knives.
- Life expectancy is at least 8 times longer.
- Annual savings per pump (plant has 4 pieces alike) just knives are just over $12500/Pump.
- Reduced number of stops in these pumps as well as in subsequent processing equipment , reduced working hours for exchanges and a better working environment.
- An assumed but not yet measured better digestion yield in the process.

Project participants

PTC-innovation AB
www.ptc-innovation.se
- Application and process development, manufacturing processes.
HVAF M3 thermally sprayed coatings in this project.

MSI Teknik AB
www.mamut.net/msiteknik
- Machine Service and Industrial technology process industry, an expert on this kind of pumps and manufacturer of knives in this project.

Innovatum, Production technology centre
www.innovatum.se/starta-och-utveckla/produktionstekniskt-centrum
Unversity West Trollhattan
www.hv.se
- Initial test-project

Test & Demo metallic materials project,
www.testochdemo.se
- Support for test series of knifes