MMM in Liquid Metals Processing, Extrusion and Drawing Applications

1. Why are Conventional-power ultrasonic systems limited in function and adaptability to new metal working applications? Which are the advantages of the MMM ultrasonic generator technology?

Our MMM technology is offer new possibilities to apply ultrasonic energy to "UN-TUNED" arbitrary shaped mechanical systems. As you may know conventional high power ultrasonic systems must use TUNED probes or work pieces. For conventional systems this limits the possibilities for making casting probes from special heat resistant materials; in wire drawing applications it is difficult to use standard dies; in tube drawing very special tuned dies must be used and due to heavy forces conventional ultrasonic systems have trouble tracking resonance frequency shifts. In most extruder applications conventional systems cannot apply suitable power and cannot properly stimulate the working tool.

Our MMM generator can apply ultrasonics to most any mechanical system including large and heavy tools like extruder heads, dies, and new probe materials. Although it is not always possible to produce very high amplitude to very large or unusually shaped systems we can deliver effective high power that will generate uniform ultrasonic stimulation to the tools. Rather than focusing a fixed wavelength to the point of work our technology is working to stimulate many resonant modes through complex signal modulations that are created from an intelligent feedback system. See the attached document about our MMM technology.

With our MMM technology we have developed some new concepts for:

Using high temperature materials for ultrasonic casting

Applying ultrasonics to standard extruder heads

Applying ultrasonics to standard wire and tube dies

All of these applications should be considered cutting edge technology that is part of on-going development. We are seeking partners that wish to improve their processes and are willing to make an investment in testing and adaptation.

2. Does it improve metal homogenizing and allow mixing of new alloys previously difficult to make?

YES, Ultrasonics is known to improve metal mixing of normally incompatible alloys. I suggest you read books published by Russian researchers Abramov and Eskin. Attached are the details of one book by Abramov, when you find it look at Chapter 10. The book by Eskin is also very good and specific to ultrasonic metallurgy. For quick reference Abromov makes the following claims:

The ultrasonic treatment of molten industrial aluminum alloys was found to enhance their purity, cast ability, the density of as-cast and wrought products, and the quality of ingots and castings. Ultrasonically treated wrought the aluminum alloys also exhibit and increased density.

It is seen that the efficiency of ultrasonic degassing largely depends on the chemical composition of melts, supplied acoustic power, and the rate of metal casting.

Apart from removing bubbles from melts, ultrasonics induces flotation of solid nonmetallic particles and thus lowers their content in aluminum alloys by 10-20%.

The vibration of solidifying melts leads to structural refinement of metals and improves of their properties. Ultrasonic defects on the properties of the as-cast materials can be summarized as follows:

1. Reduction in the mean grain size;

2. Control of columnar structure and formation of equiaxial grains;

3. Vibrations in the distribution of phases in terms of their relative amounts, structural refinement, and mutual geometry;

4. Improvement of material homogeneity and segregation control;

5. Uniform distribution of nonmetallic inclusions.

The use of ultrasonics In continuous casting is probably most promising. In this case, vibrations may have relatively low intensity, since the amount of metal that solidifies per unit time is constant and rather small.

These claims are backed up by other studies and should be applicable to most metals.

3. Which is the amplitude of the vibration?

If we use conventional tuned probe elements the amplitudes are normally in the range of 10 to 18 micrometers from the converter. In normal high power applications we can further amplify with booster elements by up to 2.5 times depending on the materials and size of the probe. There is a trade off between amplitude and force that must be considered for each application. High amplitude is not necessarily important in metal casting or extrusion applications.

4. Does ultrasonic improve some metal characteristics such as hardening, stress….?

In metal casting yes, see recommended books. In extrusion it is more of a surface improvement.

5. Why is the extrusion faster?

Ultrasonics is reducing friction between the die and metal wire, tube or profile.

6. Why do we get less breakage? Have you got any data of any particular application?

Ultrasonics in wire or tube drawing or extrusion is reducing breakage by reducing friction and required pull force.

7. Is it possible receiving a schema of an application? Plastic extrusion for example? It's to see which part of the tool is vibrating.

Attached is a picture of an example plastic tube extruder. Depending on the application we can apply ultrasonics to the outer die or the inner die. Our MMM ultrasonic generator is allowing new flexibility to drive un-tuned mechanical systems.

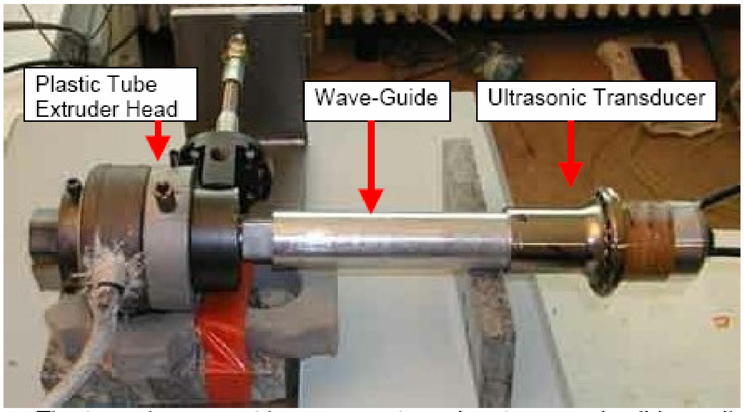
8. Have you already applied this MMM generator to any extrusion, casting …application? Which ones?

Yes, we have used for plastic tube extrusion, food extrusion, and wire drawing. We are actively involved in some projects for plastic injection molding, metal casting, tube drawing. Most projects are proprietary so we can only discuss general principles and how our technology can be applied. We cannot publish detailed information.

Example Extruder and Drawing Tools

Plastic Extruder:

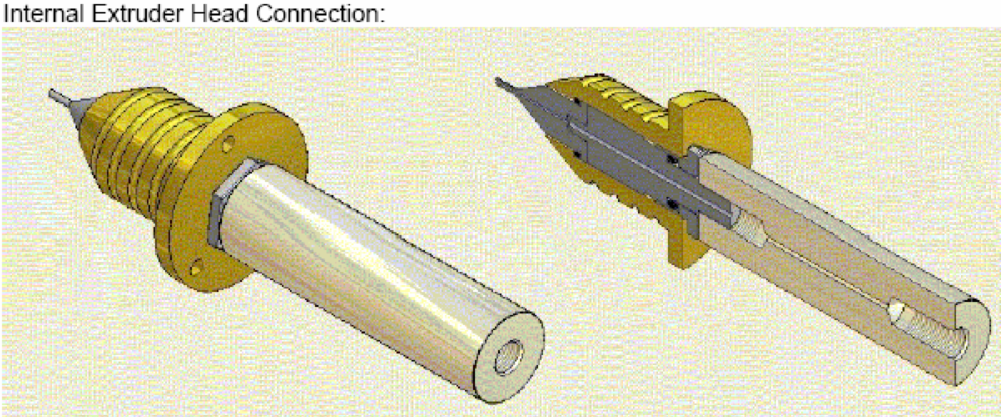
External Extruder Head Connection:



The transducer must have a way to make strong and solid coupling to the extruder internal or external die. We normally use a wave-guide as a coupling interface. We can put water jackets (not shown) on the wave-guide to prevent excessive heat build-up to the transducers.

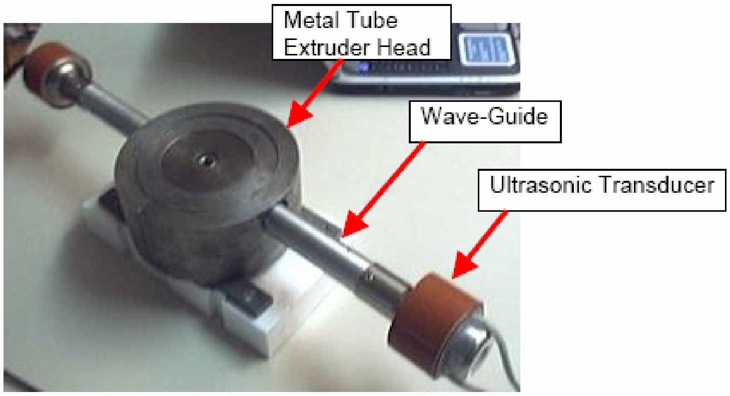
- The wave-guide in these examples is 35 mm in diameter.
- We need a smooth flat machined surface, normally Ø 25mm to Ø 35mm, for wave-guide interface.
- Normally a ½ inch UNF-20 stud is used for fastening the pieces.

Internal Extruder Head Connection:



This system was designed to improve ultrasonic surface contact with the tube material.

Metal Tube Drawing:



Wire Drawing:

Information available about new wire drawing tool design upon signature of Confidentiality Agreement.