

The following text is created specific clients (most of clients names are removed), but it is generally good and instructive for everybody in aluminum and magnesium alloys industry.

Here, I will give you short comments for fast recognition of different situations, technologies and clients, and for making fast and good decisions. Please try to present such situations to potential clients and collaborators, as follows:

1. **Easiest applications** (for us and for ultrasonic liquid metals processing) are static casting lines and static crucibles... Also everything what is similar to what we tested with magnesium in NIAT is relatively easy to present results. If we go step by step, starting with smaller projects and smaller casting lines, where it is easier to control everything, it will be easier for everybody.
2. **Worst case scenario** is if our client will immediately ask us to install ultrasonic equipment to certain big, old-fashion, mass production factory, where they have very big casting line with high flow rate of liquid metal, with not well controllable melt temperature, with metal alloy from recycled and dirty or polluted aluminum... Such clients should first learn a lot about what is possible and how to realize... (what are preferable technical and physics related conditions) for realistic and good ultrasonic processing. We should be very careful with clients who belong to such worst case scenario (or situations). Users often show a tendency to react that way... (they ask only how much ultrasonic equipment will cost, and to make it fast, and present the best results in mass-production). Existing casting lines should be conveniently modified to accept ultrasonic processing equipment if we like to have good results.
3. **Best and always preferable case scenario** (for us and for our clients) is to go step by step, from smaller R&D projects towards more demanding and more complex projects. Starting from well-defined and well controllable laboratory, university or scientific research conditions. For instance starting with static and small casting crucibles. Later we can create bigger casting lines like you had in NIAT. It is preferable to have all necessary laboratory and analytic conditions around for taking samples and making different measurements, testing and qualifications, almost in real time... To have collaboration with scientific and university experts.... And to learn about ultrasonic liquid metals processing from available literature. Later, we can extend and apply ultrasonic processing equipment to gradually bigger casting lines and equipment. Of course, existing casting lines should be conveniently modified for being optimal for ultrasonic processing, and we need to learn how many of ultrasonic processors should be installed in certain casting line, since important parameters for good ultrasonic processing results are: liquid metal temperatures and resident-processing-time of ultrasonic activity necessary to perform certain operation like degassing and grain refinement...

4. There is **generally present misunderstanding, incorrect opinion or missing knowledge** about the state of the art of worldwide ultrasonic technology and ultrasonic equipment. Badly informed, potential users of ultrasonic equipment for liquid metal processing often think that this is easily available equipment and technology on many places and this is completely incorrect.

Here we will briefly give you the following information (like very short and oversimplified overview and conclusions):

- a) Ultrasonic aluminum processing, benefits and good results are known since more than 40 years (Prof. Eskin started such research). Unfortunately, equipment developed in Russia (and everywhere else) is not good for mass industrial production (it was mostly good for getting small scale, laboratory and scientific conclusions).
- b) Until present, we can find many publications, publicity materials, books and patents regarding ultrasonic equipment for liquid aluminum processing. Unfortunately, all of that has so many weak sides and it is not applicable for continuous mass production. But many of your big competitors are trying to develop such equipment (and I know most of them, and most of them visited my labs). Problems they have are related to ultrasonic generators (electronic equipment) and materials that should be directly submersed in a liquid metal and perform ultrasonic processing. This is too wide field to be elaborated more. I have answers and solutions for all of known difficult problems.
- c) Practically, there is nobody (worldwide) who can satisfy all your demands and your expectations... Many clients are often asking questions with certain background or presumptions that they can find such ultrasonic equipment easily and ready-made, on number of places (worldwide) and this is too far from being correct.
- d) Presently, what we are doing and what we have (what you can see on our web sites) is too different, too far and too much advanced compared to what others are offering, but this is just a beginning of new projects for applying ultrasonic processing in mass production of aluminum and magnesium (for degassing, grain refinement, creating new alloys, micro-alloying, creating new master alloys, making metal-ceramic composites etc.). To explain all of that in details would also take a lot of time.
- e) We will propose you different ultrasonic processing units that will be directly applicable in your production, but I suggest that you go step by step and start with smaller capacity production, or laboratory casting lines. Learning and adjusting process and practical optimizations are taking a time.
- f) Your production line for continuous aluminum casting should be conveniently prepared (modified or adjusted), that we can install our ultrasonic processors there. This is the process that could take several months of joint work (our and your experts).
- g) You need to have your team of experts and engineers, dedicated only to this project (to ultrasonic aluminum processing). We will have a lot of joint work and your engineering team should participate and collaborate.

- h) Your experts should be able to create drawings in Solid Works (or another high level CAD software), and should be well informed to describe your technological, and production lines in all details. We will ask lot of questions, ask you to send us photos and drawings from your production to see where and how we need to place ultrasonic processors. Our ultrasonic equipment should also be slightly modified to fit your production lines.
- i) This is the capital investment in new technology, and should be considered as very significant, strategic project. It is not just to buy something from us, and you will continue working alone. You need to involve your top management and to create proper working and R&D environment in your company. I am telling you all of that from our experiences collected during long time, when we worked with others. This is also relatively expensive technology (you will need to dedicate significant financing funds for such projects, since different experts, equipment and preparatory works should be properly financed. You need to include young and motivated, energetic and well educated engineers (from the fields as: metallurgy, modern mechanics and automation). Without such structure on user's side we will not have good results. ***Your visit to MPI in Switzerland will be very useful, since you could get much more of very important information.***
- j) Our design of ultrasonic equipment is original and we do not have competitors (you can find number of information about other sources of ultrasonic equipment for metallurgy, but this is not comparable to our design solutions and presents mostly publicity and marketing activities without real industrial and technological potential, or some of authors just need to publish something for keeping their academic positions). What we have is not a standard ultrasonic equipment you can find in any other place.

For realizing ultrasonic degassing and grain refinement it is recommendable to have two ultrasonic processors:

-One operating in the casting line where liquid aluminum has relatively high temperature (good for degassing),

-And one that will be placed closer to the final casting place or mold, where liquid metal naturally has lower temperature (good for initializing and stimulating fine grains crystallization).

In order to be sure about optimal (technological) liquid metal temperatures for degassing and grain refinement, MPI needs to get from User's samples of aluminum alloys you intend to use for ultrasonic processing, and we will make parametric testing in our laboratory. Later, we need to discuss with User's experts how to satisfy optimal technological conditions. Technical parameters such as operating temperatures should be absolutely respected if we like to get desired results.

-Next joint activity (between User and MPI) is to prepare conditions within existing casting line, where we will be able to place and fix ultrasonic processors. MPI is producing some kind of mechanical (controllable) lifting device, as a holder for ultrasonic resonator. Practically, we will need to organize joint design work, make

realistic 3D modeling (to present what we will produce and place there), slightly modify your flow channel and customize our lifting device to fit to your casting line (since this is kind of mechanical frame, or holder, and we need to respect available space you have). MPI designers will initially make necessary 3D drawings, and User's designers will give necessary information and later interactively participate in modifying drawings, until we conclude that we have what we need and what can be produced. For getting better feelings or impression about what we will install on/in User's casting lines it is recommendable that somebody of User's R&D members place a visit to MPI laboratory in Switzerland.

As you can see, for realizing such projects, it is not enough to sell you only piece of ultrasonic equipment. We need to organize how to apply ultrasonic equipment in User's real production conditions, we need to be sure to have good air cooling, electric energy supply, basic thermal protections etc., meaning that one part of the price is for MPI ultrasonic equipment, then additional price is for consulting and design activities regarding 3D modeling and redesign of proper mounting frame and holders, then our parametric testing of your alloys in our laboratory (including our know-how and consulting) also has certain price. We also need to prepare drawings for you to explain how and where you need to modify certain casting line channel (meaning highly professional designers should work on both sides)... and there are always number of other smaller (not counted) activities in such process. This is also kind of learning and technology transfer process, since you will learn from us what is possible, what is not possible, how and where to apply ultrasonic processing, what to do and what to avoid, and all of that has its industrial and technological property value. Of course, this time we are not discussing about technology transfer or selling technology rights and similar industrial and business property items.

Usually, regarding similar projects and collaboration MPI is asking clients to accept (to sign an Agreement or Contract) the obligation not to patent something what is directly and closely related to our project (neither in Russia nor in any other country). Of course, other arrangements are imaginable in case if we make such Contract (what will have different price).

Here is the RESUME. Please translate it well and use it as arguments for establishing projects with different clients.

- 1. Our opinion is that we will every time apply ultrasonic degassing after the filter box (because metal temperature there is high enough for degassing, and metal is already filtered and ready for degassing). If there is not enough space in a degassing box and around, we need to make small modification of a flow channel and create place for our sonicator tube (just after the degassing box). This is the reason why we need pictures and drawings of degassing box (and space around), and in this case we need to collaborate with a client to create necessary documentation and design proposals, how and where to modify casting line or flow channel.*

2. *For DC casting we need to design very specific, customized mounting and holding frame, or lifting device in order to be able to apply ultrasound directly in a sump. For this design process we need to have real dimensions of the casting place (close to the sump), including pictures, drawings, and if possible some movie showing the casting of ingot... Based on such data we need to create necessary mounting frame and lifting device for ultrasonic processor unit (for our sonicator).*
3. *Ultrasonic optimization and modification of master alloy is very good idea and project... this could be beneficial in all kind of castings. We will continue working on this project. You know our discussions about ultrasonically created master alloys...*
4. *If we need to mix different metal components, and if this is making problems in Client's place, your idea to create an independent mixer (specific crucible) with mechanical mixing and ultrasonic processing inside is very good (something similar like we discussed for Kaluga project). This way, if Client is using recycling grade, old and dirty scrap metals, we will first create good, homogenized alloy (meaning produce ingots), and later we can use such ingots for standard casting lines.*
5. *Liquid metal temperatures are decisive (very critical and very important) parameters for good degassing and grain refinement. Other important factors are resident processing time (duration of ultrasonic radiation to realize desired effects), and geometry or shape of casting lines and places where we will install sonicators... In some cases maybe we will need to apply several sonicators in different positions... This is also part of R&D, consulting and belongs to a learning process (technology optimization).*
6. *As you can see, Client needs to have kind of professional designer's team (engineers), and we need to make lot of preparatory design work in order to be able to apply ultrasonic processor units. This introductory work is a kind of consulting and design work and should have its price (it will take several months to make proper 3D and 2D documentation, and it will take a time until we produce proper mounting and lifting devices and modify casting lines). Cannot be just informative discussion free of charges. Client should be really and tangibly committed to such projects, and not only ask to get piece of ultrasonic equipment and place it where they like... It is much better for Client to create proper R&D lab and pilot plant (smaller size casting line) in order to test ultrasonic technology... and to be connected with certain university where Metallurgy is the main subject. From all of your and Client's feedback I see that they do not care about creating such scientific, R&D and technological environment. They just select worst case scenario, which could be summarized as: give me ultrasonic toy and I will play and I expect to get perfect results... NO need to go to smaller casting plants and test and learn, no need for R&D, no need for consulting and joint team work, no need to include university professors, no need to invest in technology modernization in Client's place... Please try to convince them that worst case scenario only looks like best decision,*

but it is strategically wrong, and taking into account long term interests of Client, it is not recommendable... Anyway, if we will be well paid, we could collaborate in any conditions. We cannot start our consulting work if we do not secure financing of this introductory, consulting phase... If Client likes to have long discussion process and if in this process we are well paid, they could prolong the process as much as they like, but we need to insist on 100% satisfaction of here mentioned technical and technological conditions (from 1. to 5.).