SPRING 1999

ATOMISING NEWS

CONTRACTS

Leading Chinese Solder Company Buys Ultrasonic Atomiser

A contract was signed in April for ASL to supply Yunnan Tin Corp with a complete computer-controlled electronic solder production system. This will be the first installation in China to produce the highest quality solder powder for use in the assembly of electronic circuitry, a major industry in China. Yunnan Tin Corp is one of the largest tin producers in the world, situated in South West China. The plant will be installed in the city of Kunming and ASL will be training staff in the UK before it is shipped.

John Dunkley with Gao Wen Xiang of Yunnan Tin Corp and Ye Shutian of Yunnan Provincial Imp/Exp Corp.

ORGANISATION

Engineering Department Expands

After a consistently high level of activity during 1998, it was decided to expand our engineering office. John Milnes, who has worked for us on a sub-contract basis at times over the last five years, has joined Roger Walker and Craig Winfield on the design and project engineering team. Sandra Foster completes the team in our engineering office and is responsible for procurement and shipping.

Contents Page

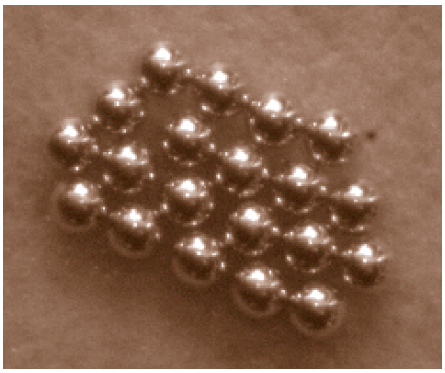
COMPANY NEWS

The last 6 months has been a busy time for us, both in our design office and our R&D programme. ASL has delivered 6 water atomising heads to a range of customers as well as working on upgrading several gas or air atomisers. Our website has been further expanded and is worth a visit if you are interested in information on a wide range of atomisation techniques. We have expanded our engineering department capacity and are ready to cope with further major projects in the year ahead. Following the success of our ultrasonic solder atomisation system, we are investigating novel methods to produce very fine solder powders, from 5-25 microns, and coarse monosize solder balls from 100 - 800 microns.

MIT Process for Monosize Spheres

It has been well known for many years (Lord Rayleigh's famous paper was published in 1873) that if a jet of liquid is perturbed at critical frequencies, it will break up into uniform droplets. This is sometimes described as vibrating orifice atomisation. While cold liquids have been treated in this way in ink jet printing and to make calibration droplets for experimental work, experiments on molten metals showed that it was far from easy to achieve a really monosize distribution where the standard deviation might be as low as 1.02 and 99% of particles lie within +/-3% of the median.

Professor Jung-Hoon Chun, from the Department of Mechanical Engineering at MIT, has finally demonstrated that the problems of working with molten metal can be overcome. In an elegant combination of advanced materials, precision engineering, ultrasonics, electrostatics, imaging technology and advanced computerised control software, his team have constructed pilot units that make thousands of particles per second with extremely narrow size range and excellent sphericity.



300µm 63Sn/37Pb spheres.

The technique, protected by patents (US 5,226,098) consists of forcing the melt through a sapphire nozzle with diamond honed bore to form a jet into an inert gas filled chamber. The jet is perturbed by a piezocrystal system driven by a variable frequency generator and amplifier. The droplets are charged electrostatically so that they repel one another and thus do not collide in flight. The stream of droplets is imaged at high magnification by a CCD camera system and the image analysed to provide in-flight real-time measurement of diameter. Any deviations are used to vary the vibration frequency through a specially developed control algorithm. The result is a compact (1.7 m tall, 1.5 square metre area) and low energy (ca 1kW) system that operates reliably for many hours producing identical spheres with sizes that can range from 800 microns down to below 100 microns.

These solder balls find application in electronics for surface mount technology (SMT) where Ball Grid Array (BGA) techniques, which allow hundreds of close pitch connections to the base of a chip, are growing in importance. Already MIT has licensed several producers in the USA and Japan and production has already started.

ASL has visited MIT to offer its services to build the systems which current licensees have had to make for themselves. We are also helping a new start-up company which is developing the technology for higher melting point metals, including steels. There are many problems to be overcome to make this possible, but the prize is a production technique of unique size control capability. We hope to bring you news of progress in future editions and refer you to US patent 5,226,098 and to the International Journal of Powder Metallurgy, April 1996, pp 155-164 for more information.

Prof. Chun can be contacted at the MIT Manufacturing Institute on:
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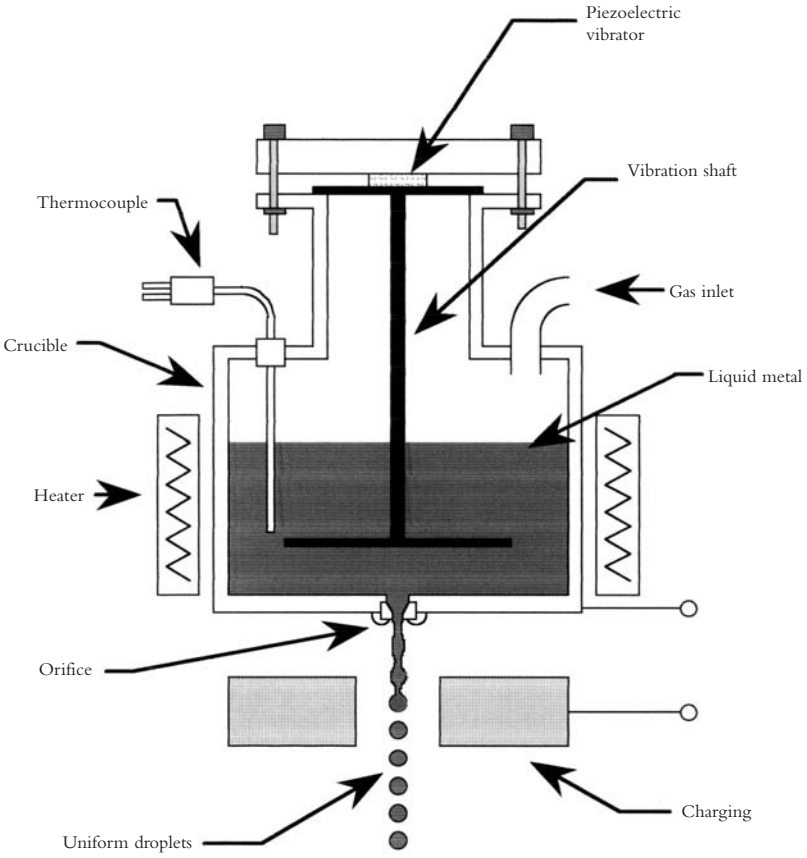

TECHNOLOGY

ASL Sign Agreement with Sheffield University

As announced in our last edition, ASL has been discussing co-operation with Sheffield University with a view to forming a multi-disciplinary research group combining the resources of its Engineering Materials, Mechanical Engineering and Chemical Engineering departments with ASL's specialists. An agreement was signed in March 1999 providing for the donation of a special R&D atomiser, designed for work on water or liquid hydrocarbon atomisation. This will be installed in the University's Materials Department laboratory and a programme of empirical testwork, with associated theoretical and modelling work will be undertaken in association with other departments. The unit will be capable of operating at water pressures of up to 250 bar and air-melting metals melting at up to 1600C.

It is planned that the unit will be installed, and training completed, during the summer. ASL will have access to the unit for its researchers and technicians, and will be able to offer to carry out special melts or small test programmes for individual clients.

Water Atomiser for confidential client being assembled in Sheffield. Capacity up to 150kg/min of steel.

EVENTS

International Conference on Sintering

The International Institute for the Science of Sintering is holding its seventh conference in New Delhi from the 22nd to the 25th February, 2000. All aspects of the sintering of metals and ceramics will be dealt with. For further details contact:-

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TECHNOLOGY

Water Bench Trials Results

As reported in our last edition, our upgraded water bench system for testing close-coupled gas atomisation nozzles was available. It has now been in routine operation for several months. Much of the work is proprietary to specific clients, but some general observations can be reported here.

It proved possible in one case to develop a nozzle assembly design which, after adjustment on the water bench, gave metal flow rate within experimental error (~ +/- 10%) of that predicted. This close-coupled nozzle allowed the production of powder with a 30% finer median size using a gas pressure only 25% of normal level and a flow of one third of normal, thus making major energy economies.

In another case we were able to test a client's nozzle and detect a problem with a repair that had led to off-centre gas-flow and metal back-streaming off the nozzle on one side. It also showed a high degree of sensitivity of melt flow to ceramic insert geometry. These insights are allowing much faster solutions to operating problems.

If you have an old gas or air atomisation system, why not call us to discuss its performance and whether we could improve it?

TECHNOLOGY

Gas Atomiser Installed for Nozzle Development Programme

ASL aims to be a leader in the design of gas (and air) atomisation nozzles. To this end we have installed a test facility, the "water bench", which allows study of melt flow rates and patterns when atomising water as a model liquid. However, we need to generate data on the efficiency of atomisation in terms of actual particle size, and we cannot do this with water. Thus a small atomiser (see photo) has been installed in our laboratory to allow trials on zinc melts of 5-10 kgs using air as the atomising medium. This uses the compressor set installed for the water bench and allows us to verify the effects of the modification of both gas nozzles and of ceramic melt nozzles.

Zinc has the advantage for model work of being non-toxic (unlike Pb), non-explosible (unlike Al) and low melting, allowing us flexibility to machine nozzles from cheap machineable ceramics. We plan to investigate systematically the effects of ceramic and gas nozzle geometries on atomising performance with a view to achieving a high efficiency (defined as achieving the finest possible powders using the lowest gas flows and pressures) and, possibly just as important, a robust operating regime allowing economical manufacturing tolerances on ceramic parts and low sensitivity to degradation of performance in service.

EVENTS

International Conference on Atomisation - 2000

While the atomisation of cold liquids has its own very active conference circuit - ILASS, the atomisation of melts seldom interests more than a few percent of delegates. The Powder Metallurgy industry has also a successful series of conferences but again atomisation of metals powders is very much a minority interest. John Dunkley was thus very pleased to accept an invitation to join the organising committee of the International Conference on Spray Deposition and Melt Atomization (SDMA) to be held at Bremen, Germany, on June 26-28th in 2000. It is organised by the Institut Fur Werkstofftechnik and Prof. Dr.-Ing. K. Bauckhage, whose group is very active in the field.

Papers covering all aspects, both experimental and theoretical, of the subject are requested and three copies of a 6-800 word abstract should be sent to:-

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Copies of the call for papers are available from ASL.

EVENTS

Vancouver PM²TEC99 Conference

ASL will be exhibiting at this year's North American PM industry conference in Vancouver from 21 to 24 June. John Dunkley will also be presenting a paper reviewing gas atomisation techniques. We look forward to meeting many of our readers there.

LITERATURE

Las Vagas PM²TEC98 Proceedings

The proceedings of this North American PM conference are published by the MPIF as Advances In Powder Metallurgy & Particulate Materials-1998 compiled by J J Oakes and J H Reinshagen in three volumes. They contain six papers on atomisation in Volume 3, Part 10, to which all page numbers refer below.

"Low Pressure Close-Coupled Gas Atomization" by J T Strauss of HJE Company Inc, (pp 3-11). This presents data on close-coupled gas atomisation of copper with high (2.4MPa) and low (1.7MPa) pressure nozzles and concludes that the costs of high pressure operation may not be justified.

"Application of Computational Fluid Dynamics to Analyze the Gas Flowfield of Single-Discrete Jets" by C-J Yu and I E Anderson of Ames Laboratory, Iowa State University (pp 13-29). This models the aerodynamic performance of gas jets of ideal Laval profile, simple conical expansion, straight bore and convergent. The results are interesting, but the bold assertion that they mean anything in atomisation terms is not justified in any way (but see below).

"Design and Testing of an improved Convergent-Divergent Discrete-Jet High Pressure Gas Atomization Nozzle" by J Ting, I E Anderson, R Terpstra and J Mi of Ames Laboratory, Iowa State University (pp 29-39). The HPGA (High Pressure Gas Atomisation) nozzle operating at about 3.1MPa was redesigned with convergent-divergent jets of optimal design and with low interjet angle (22.5 degrees). It performs slightly better than the MkII design, giving 35 micron stainless steel at 0.8 kg/kg gas/metal ratio instead of 42 microns. Operating at 8 kg/min this is rather good performance.

"Modification of High Pressure Gas Atomization Processing to Enhance Fine Powder Yield" by I E Anderson, R L Terpstra, C Patterson, J Steiber and J Moore of Ames Laboratory, Iowa State University (pp 41-55). This reports work on the HPGA MkI nozzle in the unique atomiser at Ames. A problem with atomising copper which deposited on the vessel was overcome by adding cryogenic boil-off gas to cool the atomiser plume. Satelliting was also investigated, but is difficult to measure. It was found that aspiration did not predict metal flow. Some tantalising possibilities arise for further study.

"Production of Ultra-Clean Gas Atomized Powder by Plasma Heated Tundish Refinement" by T A Tingskog of Anval (pp 57-67). This describes the benefits of the 6 tonne capacity plasma heated tundish. In particular powder slag inclusion levels are greatly reduced, to levels approaching ESR.

"Recent Experience of Water Atomisation" by J J Dunkley of Atomising Systems Limited (pp 69-75). This outlines work and ideas on production of iron powder, fine silver powder for electric contacts at 500 bar, stainless steels and mattes (sulphide intermediates) in smelting of Ni, Cu etc.