

TECHNOLOGY

ASL's Anti-Satellite System Starts up

As reported in Atomising News (No 12 p42) ASL was awarded a SMART grant by the British government in early 2000 to develop an "anti-satellite system" to improve the sphericity of inert gas atomised powders. The problem of satellite particles (small particles welded to the surface of larger ones) seems to become more and more prevalent as finer powders are produced. Our plans to develop this method were stalled until construction of the gas atomiser was complete. In June 2001 design work began on the special anti-satellite system, with installation completed by the end of October (fig. 1).

The patented idea rests on the concept that satellite particles are due to collisions between semi-solid atomised particles in the atomising plume and cold, solid fine particles entrained into the atomising plume by the gas jets. To prevent this, it is necessary to ensure that the gas which is inevitably entrained into the atomisation plume is not loaded with fine particles. This is done by removing large volumes of gas from the base of the atomiser, passing it through a cleaning device (in our case a large cyclone) and recirculating the cleaned gas to the area around the atomising jets.

A useful side effect of this is that the view into the chamber, instead of resembling a sand-storm with very poor visibility of the atomising plume, is hugely improved, as is obvious from the background photograph, showing copper being atomised to a powder with a median of 25µm.

The micrographs (fig. 2 and 3) show typical views of a coarse sieve fraction of the powders produced by the same nozzle under

identical operating conditions, but with and without the anti-satellite system. The improvement is very clear.

We are in the very early stages of evaluating this concept, but initial results are most encouraging and we expect that operators of gas atomising plants will find it useful to have trials carried out on their alloys to evaluate the improvement. We believe that this system can be retro-fitted to existing systems if required. A paper on the process will be presented at the 2002 world PM congress in Orlando (see page 52), and we will report progress in our next edition of Atomising News.



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Fig.1 The Anti-Satellite system installed on ASL's gas atomiser

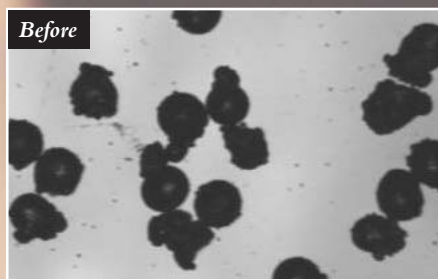


Fig. 2 Atomised powder before fitting the Anti-Satellite system.

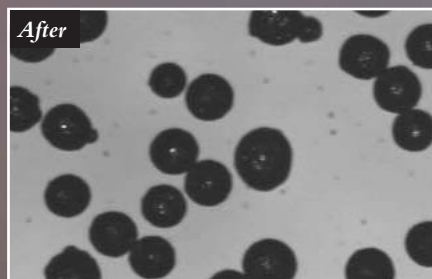


Fig. 3 Atomised powder after fitting the Anti-Satellite system. The improvement is clearly visible

Particle Size Analysis of Atomised Powders

With this edition of *Atomising News* we enclose a complementary copy of a log-normal graph processing sieve or other size analysis data. Here John Dunkley explains how useful this can be.

THE LOG-NORMAL GRAPH FOR POWDER SIZING

Many ways are used to describe atomised powder particle size distributions. Graphs of individual sieve fractions are very difficult to use. Cumulative % undersize graphs are much better, but with linear axes the data is very distorted. Using a log scale for the particle size results in an "S" curve which is of some use, but the best solution is to use log-normal paper as attached. This has one Gaussian axis and one log axis. In most cases an as-atomised distribution will show something close to a straight line, and the whole data set can be described by just two numbers; the median size (D50) and the standard deviation (σ) calculated as D84%/D50% or D50%/D16%. Most two-fluid (gas, air, water) atomised powders have σ in the range 1.8-2.5. If it is above 2.5, atomisation is probably very poor, and possibly bi-modal (i.e. producing a mixture of a fine and coarse distributions).

These log-normal plots are very useful in detecting problems. These include:-

1. Loss of fines

This is sometimes found in water or gas atomisers where dewatering is not efficient or the gas cyclone or filter is not performing. It may be difficult to detect using sieves, but the data from a sub-sieve machine (laser etc) may show the problem very clearly when plotted. It takes the form of a strong deviation below linear at the fine end. If the loss of fines is more than a few % then it should be obvious on the plant (large dust emission, dirty recycle water etc). If the fines are being dissolved or agglomerated, maybe by corrosion in drying, a similar effect may be seen.

2. Loss of coarse

Here the coarse end of the graph will kick up above linear. Some gas atomised distributions have a smooth curved appearance deviating from linear in this direction, but a sharp kink in the curve is suspicious. This is very common in sieved powders, and if a sample has been sieved, it should be observed. (Case 2 on the graph shows a powder sieved at 355microns). If it is as-atomised, then one reason can be splatting of coarse particles on the vessel walls, leading to large particles being retained in the system. Bad sampling can also cause this.

3. Holed or blocked test sieves

These show up very clearly as sharp steps in the line. Any deviation of a point more than a few mm from the best line should lead to an immediate visual inspection of the test sieves. 3a and 3b on the graph show these effects.

4. Fluctuations in atomising conditions

If excessive coarse particles are evident, as by the line deviating below the straight line at the coarse end (graph 4 shows 5% extra coarse), then this indicates inadequate atomisation such as metal escaping the atomising jets without proper atomisation. If the distribution is simply getting broader (σ getting larger) this can be due to more subtle effects, such as small variations in metal flow rate in gas atomisation, which will move the distribution coarser or finer at that time, and on average over a long period broaden the distribution while staying apparently log-normal. Of course if the D50 changes, this also points to some change of conditions, maybe melt temperature or chemistry, but

more likely pouring speed (nozzle erosion or partial blockage).

5. Agglomeration effects

If fine particles agglomerate to make coarser ones, the shape of the distribution will change. Agglomeration can occur due to sintering of ultra-clean powders in gas atomisation (especially lower melting alloys collected at raised temperatures). In water atomisation, corrosion in drying ("caking") can have a similar effect. To check for this, examine under a microscope any coarse fraction from the sieve analysis that looks suspiciously high. If the sample powder looks caked and does not flow well, be aware that it may spontaneously agglomerate on the test screens. Such agglomerates may be broken up by brushing, but indicate that the powder is not well suited to sieve analysis and other methods (Laser, Coulter, Sedigraph etc) may be more suitable. Damp in the test sample can also cause this.

6. Sampling errors

Depending on severity, these can show up more or less clearly. Segregation can result in over- or under-reporting of fines or coarse (see 1, 2, 3b, 4). If the system in question normally gives an excellent straight line then any deviation from this should be viewed with suspicion. Sampling is a very difficult operation, best carried out automatically. If it is done manually, a systematic method needs to be established. If the plotted lines change, it is well to question whether the same operator carried out the sampling, and to request a re-sample. Sample splitting in the lab is equally important.

ASL Commission Gas Atomiser

Following the move to new premises in December 2000, Atomising Systems Ltd. spent the first half of 2001 designing and installing new equipment. The new inert gas atomiser that we have installed is fitted with a 150kW induction furnace, giving a choice of two coils with nominal capacities (steel basis) of 50kg and 150kg. The atomiser is fully instrumented with a computerised data acquisition and control system monitoring temperatures, pressures and flow rates (see picture). After start up on zinc, the unit has been used to make various copper-based alloys and then iron and cobalt alloys. The nitrogen supply for this atomiser and for our other requirements on site comes from a full-scale cryogenic nitrogen supply system, rated for 30 bars operating pressure. In November the anti-satellite system, which had been constructed for our SMART project (see Atomising News No. 12 p42), was connected up and tested – see the separate report on the front page (p49).



The PC/PLC control system that enables many parameters to be varied and monitored

A lab scale 5kg atomiser for either gas or water atomisation has been installed as well as our water bench for testing gas atomisation nozzles. The former QQ Solders ultrasonic atomisation system has also been installed in the new premises.

CONTRACTS

Large Water Atomiser Commissioned

As mentioned in Atomising News No 12 p41, ASL were awarded a contract in 2000 to engineer a large water atomiser to process smelted FeCuCo alloy at Chambishi Metals in Zambia. This project, involving an investment of over \$100 million in a 40MW DC arc smelting furnace, plasma heating station, atomiser and hydrometallurgical refinery for cobalt and copper extraction and purification, has been commissioned during 2001. The atomiser processes 10-15t ladles full of alloy at a design rate of 500kg/min (30t/hour)

Despite some problems of the type to be expected in such a novel and complex project in a remote location, the atomiser is now in regular operation and processing alloy.



An atomising run in progress at Chambishi Metals

CONTRACTS

Another Ultrasonic Atomiser For Solder Powder Goes to China

We are in the process of delivering an ultrasonic atomiser for the production of electronic grade solder powder. The atomiser will be installed and fully commissioned by the end of the first quarter of 2002.



The latest Ultrasonic Atomiser pictured at ASL prior to dispatch

CONTRACTS

Boliden Contech AB Orders Another Water Atomiser for China

After the successful commissioning by ASL, in August 2001, of a water atomiser for the processing of gold alloys for Boliden Contech's Chinese client, a second system has been ordered.

Boliden Contech, who are supplying the precious metals refining circuit to a second Chinese client, have placed the order with ASL for another atomisation system. This system will be delivered to the client in the first quarter of 2002.

SERVICES

Special Powder Service Launched



ASL's Paul Kerrigan checks the melt temperature during an atomising run

Following the successful commissioning of our gas atomiser, ASL has broadened the range of special powders that it can offer to clients wanting modest amounts of powder on a regular basis or one-off experimental lots. Already our former QQ Solders operation supplies significant amounts of high purity spherical solders made by ultrasonic atomisation, both lead free and leaded. Quantities from 10-1,000kgs can readily be supplied and limited stocks are held of some grades.

Water atomising of 5kg lots of alloys melting at up to 1450°C can also be done, with recent work including silver based and iron based alloys.

Now we can offer nitrogen gas atomised powders, in lots from 25kg to 150kgs with capacity to produce a few tons if required. Alloys with melting points up to 1500°C can be processed and mean particle sizes from 100 down to below 30 microns have already been produced, with oxygen contents as low as 100ppm.

Contact Dr Paul Rose (pr@atomising.co.uk) with your requirements.

PM²TEC 2001

New Orleans USA

The International Conference on Powder Metallurgy and Particulate Materials, PM2TEC 2001, was held in New Orleans on the 13-17th May 2001. The venue was the Hilton New Orleans Riverside.

ASL was represented by John Dunkley who presented a paper on gas atomisation. Eight or nine papers were presented on atomisation and these can be found on the CD-ROM of the proceedings. They will be published shortly by MPIE.

PM2001 Nice France

The European Congress and Exhibition on Powder Metallurgy (PM2001) was held at the Acropolis Convention Centre, Nice, France on the 22-24th October 2001.

ASL were present, with a busy booth in the exhibition and presenting a paper in the technical sessions.

The sessions contained, as well as many other topics, eight papers on atomisation. The atomising papers can be found in Vol 4, Forming 2 and Other Processes, of the proceedings, available from the EPMA.



Contact us if you would like a copy of our new brochure.

COMPANY NEWS

ASL's Nordic Agents

ASL has been assisted in Sweden, Norway, Finland, Denmark and Iceland, by its agent K.O. Rydqvist AB, for some time now.

If you require any information, Dr Dag Svedung at K.O. Rydqvist can be contacted on the following numbers:

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A Short Course on Metal Atomisation

Professor Andrew Yule of UMIST writes:- I am very pleased to take this opportunity to introduce a new 3 day advanced course entitled "Spraying Metals and Other Melts". ASL's chairman, John Dunkley, and I have had plans for such a course since publishing our book *Atomization of Melts* for Oxford University Press in 1994. At last our plans have come to fruition and the course will run between 13th and 15th February 2002 in the Britannia Hotel in central Manchester. As well as John and myself we are fortunate to have contributions from experts such as Patrick Grant and Sam Harris, from the Universities of Oxford and Nottingham respectively. We have designed the course to meet the needs of industrialists, academics and researchers involved in spraying molten

substances, particularly, but not exclusively, metals.

For more information and registration details please contact either John Dunkley at Atomising Systems Ltd, or Alan Wells at Perdac Ltd, which is the University of Manchester "Campus Ventures Ltd" company responsible for operating short courses: awells@perdac.com phone +44(0)161 2768374 fax +44(0)161 2735111

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FUTURE EVENT



PM²TEC 2002 The World Congress in Florida USA

The World Congress on Powder Metallurgy and Particulate Materials, PM2TEC 2002, is to be held in Orlando Florida from the 16-21st June 2002.

The venue is the Walt Disney World Dolphin Hotel.

ASL will be present with a booth as well as the presenting a paper on Anti-Satellite gas atomisation. We hope to see many of you there.

Further information on this event may be found from:

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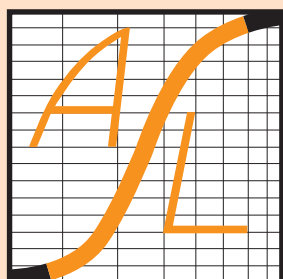
TECHNOLOGY

Papers on Gas Atomisation Available

ASL has presented several papers recently on gas atomisation including the effects of hot gas, energetic considerations, superheat effects, and the subject of gas/metal ratio, where it is argued that using kg/kg ratio, while dimensionless, is also meaningless when considering such different gases as argon and helium. Cubic metres/kg is far better, but best of all, when looking at a wide range of

metals and gases, is volume/volume such as cu.m/cu.m. This is found to make some sense of published data on Zn, Mg, Al and Cu atomised with nitrogen, argon and helium.

If you would like copies of these papers, contact info@atomising.co.uk, quoting this publication.



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