

COMPANY NEWS

## ASL Anti-Satellite System Ordered



The anti-satellite atomising vessel leaves ASL premises

At the end of 2005 an order was placed on Atomising Systems Ltd. for a large scale (500kg batch) anti-satellite gas atomiser. The system has been supplied to the client and will be commissioned in June 2006. This will be the first commercial scale anti-satellite atomiser delivered to one of our clients. The only other anti-satellite atomiser is that in ASL's own production/R+D facility here in Sheffield.

ASL's Technical Sales Manager, Paul Rose said "We are pleased that the client has selected our gas atomiser with our Anti-Satellite technology. This system will allow them to produce powders with better flow properties, giving them a real performance advantage. We expect that it will not be long until other producers are installing this technology".

TECHNICAL

## Consultancy Benefits

During the past year our Chairman, John Dunkley, has been asked to visit clients operating metal powder atomising plants in two continents to advise on improvements. Details are, of course, confidential, but the overall results are striking.

In one case, an operator of a substantial non-ferrous powder plant wished to double his output, while increasing from 2 to 3-shift operation and reduce costs of operation. After a 3-day visit, John Dunkley was able to prepare a report setting out revised operating procedures and some very simple and low-cost modifications which would allow output per shift to increase by 70% and direct operating costs per ton to be reduced by 55%.

In another case it was possible to suggest how to double output while halving the number of furnaces used, while also reducing production costs by 30%, more than quadrupling the net profit per ton. In earlier years there have been many similar examples where a thorough examination of the yields, QC systems, melting methods, screening efficiencies, metal losses, etc has allowed similar major savings in cost and increases in capacity to be identified in both gas, air, and water atomising plants. Quite often it is found that major savings can be realised without capital expenditure, simply by revising and optimising operating procedures, although modest changes to layout or equipment design are sometimes also necessary.

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# Centrifugal Atomisation

## A Very Different Method

Centrifugal atomisation (also known as spinning disc, rotary, or spinning cup atomisation) has been used for atomising cold liquids for over 50 years. The method consists of rotating a circular body and pouring liquid onto the centre. The liquid spreads out into a film as centrifugal forces urge it towards the edge of the atomiser and it accelerates until it reaches close to the peripheral velocity of the atomiser. At the edge, the acceleration force due to rotation attempts to remove the liquid from the disc edge, while surface tension forces try to hold it on.

It can readily be shown that the particle size  $d$ , depends on the liquid density  $\rho$ , the angular velocity  $\omega$ , the radius of the atomising disc  $R$  and the surface tension  $T$  as follows:-

$$d = (6T/R\rho)^{0.5}/\omega$$

Particle size varies inversely with rotational speed, increases with the square root of surface tension, and falls as the square root of density and atomiser diameter. This simple equation gives a good guide to real system's behaviour.

The simple theory predicts only one size of droplet should form. While this is certainly not true in reality, it is found that, compared to all two-fluid atomising methods, centrifugal atomisation does have a far narrower distribution of droplet sizes about the mean, and this is one of its major attractions.

The bulk (98-99%) of the powder size distribution conforms fairly well to a log-normal statistic, but in contrast to two-fluid

atomisation (gas or water atomisation) the standard deviation of the distribution typically ranges from 1.3-1.5 compared to 1.8-2.3. This means that yield in a narrow particle size range with a max/min ratio of 3:1 (e.g. -150+50 microns) can range from 85 to 90% compared to 50-55% for gas or water atomisation.

Another advantage is its modest energy consumption. In the case of a liquid being atomised at the very high speed of 100m/s and the substantial mass flow rate of 1kg/s (60kg/min) this is  $=1 \times 0.5 \times 10^4 W = 5kW$ . This compares to a typical energy expenditure for gas atomisation at such a rate of ~500kW and even for water atomisation of ~50-100kW. Of course, compared to a total loss gas atomiser, gas consumption is tiny, being only that needed to purge out the system to the desired oxygen content.

Thus, in terms of energy and gas costs, centrifugal atomisation has great advantages, to which can be added much higher yields than two fluid atomisation methods when making narrow size range powders.

### Applications

As well as cold liquids, for 50 years there have also been applications in the field of metal and non-metal high temperature atomisation. For example work at Dow and later by Valimet led to the industrial production of thousands of tons/year of Magnesium powders in the ~0.5mm range in the 1960s. Similar equipment is now used in Japan and the USA for the atomisation of zinc in the 50-500 micron size range for large alkaline-manganese battery market.

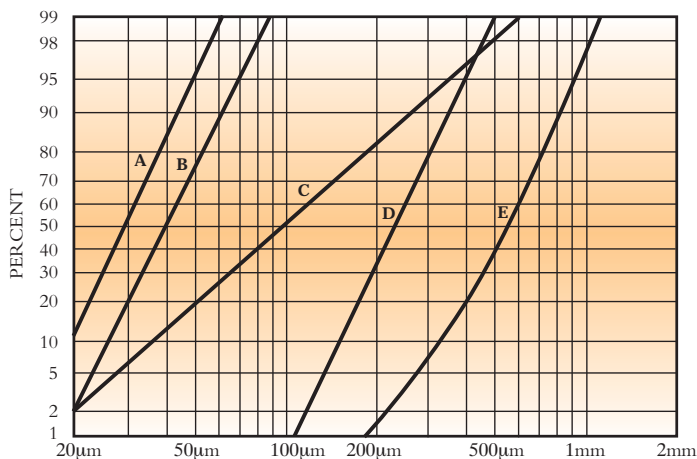
In the 1970s Whitaker Corp developed the REP (Rotary Electrode Process) in which a bar of metal is rotated and has its tip melted by an arc. This is used to make Ti, Co and Ni alloy powders of narrow size ranges, from ~50 to 500 microns. At the same time Pratt & Whitney developed the RSR process where a water-cooled copper disk is used. This is used at Homogeneous Metals to make special thermal spray powders, and by others for FeNDB powders.

In Japan, the NRIM carried out work on processing Sn-Pb solders using the technique. Because of its high density (8700kg/cu.m), low surface tension (0.5 N/m), and low melting point (183C), this alloy is suited to the process. By pushing the operating conditions close to the limit, with speeds of 60,000rpm, the median size of the atomised distribution can be around 30 microns. This, combined with a standard deviation of ~1.3-1.4, led to the installation of many such units in Japan, Europe and N America. ASL supplied a unit to a Chinese customer in 2005 which operates at over 100kg/hour.

### Design Issues

One problem with centrifugal atomisation is that it produces a spray with an included angle of 180 degrees. This means that the atomising chamber has to be rather large in diameter, compared to a two-fluid unit which typically has a spray angle of 20-30 degrees. Heat transfer from the system must be carefully considered. In the case of the large (8-12m diameter) systems, the large surface area of the system can allow natural cooling by air. Using circulation of the atmosphere to external coolers and/or water jacketed construction, allows much smaller systems to cope with high production rates when making smaller powders (e.g. 30-300 microns).

When making very coarse powders, e.g. >0.5mm, it is possible to use water quenching. This allows very high outputs to be processed, when heat fluxes can be many megawatts. While this requires dewatering and drying equipment, it allows a much smaller plant than a dry system. The largest scale work on centrifugal atomisation has been that on slag atomisation, where pouring rates as high as 5t/min (>1m<sup>3</sup>/min) are required to cope with uncontrolled tapping from blast furnaces of slag from the slag notch. A spinning cup of about 500mm diameter is used.



Particle size distribution for:- A – fine Sn37Pb solder, B – coarser solder, C – typical 2-fluid, D – Zinc, E – iron alloy

## Continued from page 66

### The Future

The advantages outlined above, combined with extensive work undertaken at ASL, makes wider application of the process, hitherto rather restricted by a lack of reliable designs, very likely. Cast iron and steel shot, which are produced at close to 1Mt/yr could be produced quite easily using water quenching to handle 10–30t/hour. Thermal spray powders, which need very narrow size distributions, such as –150+50 microns, are also a candidate, although a more challenging one. Speeds in the 10,000–30,000rpm range will be needed here.

There are many other potential markets, but current work at ASL is largely customer confidential. In generic terms it is focussed

on brittle products that are now melted, cast and crushed, giving rise to fines which must be screened out of the final product. We can greatly reduce off-size powder generation, and produce dramatically superior flow properties. Often a spherical shape is produced, while the crushed product is always blocky. Candidates include more brittle metal alloys, molten oxides, glasses (silicates, borates), halides and sulphides.

Although known for over half a century, centrifugal atomisation of melts has not fulfilled its promise. This is largely due to the high costs of each possible industry developing its own system. As reliable systems become more available, centrifugal

atomisation is certain to find much wider application where it can reduce energy and gas costs, improve yields and provide spherical particles with excellent flow properties.

This is a condensed version of the paper presented at the 2005 European PM Congress in Prague. Please contact us (e-mail) for a full copy.

## TECHNOLOGY

## Centrifugal Solder Atomiser Performance Levels Increased

After operation of the centrifugal atomiser producing solder powders, it has become clear that the 100kg/hr throughput that we claimed was a little pessimistic. The system is capable of around 150kg/hr, although this does depend slightly on the density of the solder alloy being processed.

## COMPANY NEWS

## Update on pSiMedica Collaboration

ASL is pleased to report that patient recruitment continues for pSiMedica Ltd's clinical trial (BIOSP202) for primary liver cancer in Singapore. The raw material for the product under test, BrachySil™, is atomised silicon containing phosphorus, which is produced in conjunction with pSiMedica using their dedicated ASL atomiser here in Sheffield.

pSiMedica have continued their investment in their ASL based facility by installing dedicated jet mill and classifier, plus a Malvern laser particle size analyser which ASL staff are trained to operate. ASL look forward to continuing the working relationship with pSiMedica.

## COMPANY NEWS

## New Manager of Engineering and Contracts Joins ASL

Following the emigration of Craig Winfield to Thailand, ASL has appointed a new Manager of Engineering and Contracts. He is Gary Uttley, a graduate of Sheffield University and Chartered Engineer with 15 years experience in process optimisation and plant engineering at Outokumpu Stainless Ltd in Sheffield. With his strong background in electrical, mechanical and control engineering of complex plant systems, Gary will enhance ASL's capability to offer a complete package of engineering services to clients.



ASL's Manager of Engineering and Contracts, Gary Uttley.

## COMPANY NEWS

## Laval University Water Atomiser Installed

Laval University's 25kg batch water atomiser (pictured) has already been installed and is being commissioned at the time of going to press. Professor Carl Blais has already customised the system by adding his beloved 'Boston Bruins' emblem to the gas control panel. ASL are sure that Prof. Blais will have much more success with the atomiser than the Bruins!



Laval University's water atomiser proudly wearing it's Boston Bruins emblem.



## PowderMet2006 San Diego USA

The Metal Powder Industries Federation will be holding their annual International conference on Powder Metallurgy and Particulate Materials in San Diego from 18th-21st June 2006.

Further information on this event may be found from:

Metal Powders Industries Federation

Tel: +1 609-452-7700

Fax: +1 609-987-8523

[www.mpif.org](http://www.mpif.org)

## FUTURE EVENTS



## PM2006 World Congress Busan Korea

The PM2006 World Congress and Exhibition moves to Busan, in Korea for 2006. The venue will be BEXCO (Busan Exhibition and Convention Centre). The event runs over 24th -28th of September 2006

ASL look forward to meeting many of you there, as we will be taking a booth and presenting a paper on Hot Gas Atomisation.

Further information on this event may be found from:

Secretariat of the 2006 POWDER METALLURGY World Congress and Exhibition

Tel: +82 2 508 7896

Fax: +82 2 552 3463

[www.pm2006.org](http://www.pm2006.org)

# Atomisation Course September 2006



The course by Professor Andrew Yule of Salford University and John Dunkley of ASL entitled "Atomization for Metal Powders" will run again on the 18th and 19th September 2006. The series of lectures goes from the fundamentals of atomisation through specific techniques to operation and

economics of plant. Aimed at industrialists, researchers and academics, this is virtually a 'must attend' for people in the field of metal and melt atomisation.

See [www.perdac.com](http://www.perdac.com) or contact ASL for further information.

## PAST EVENTS

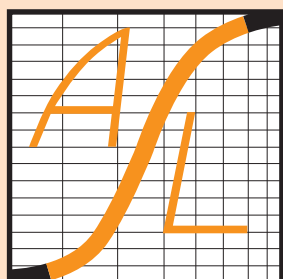
# Hagen Symposium 2005

In late November the DGM (Deutsche Gesellschaft für Metallkunde) hosted its 24th annual Hagen Symposium meeting at Hagen near the Ruhr. ASL was represented by Paul Rose and Dirk Aderhold.

There is an ever increasing interest in this symposium as evident by the increasing number of exhibitors year on year. We look

forward to the 2006 annual Symposium. The 25th of this German language conference and exhibition which benefits from select papers and professional organisation.

The 2006 conference will be on the 23-24th November. Further details from Frau Schlieper tel: 0049 (0)2331 958817 e-mail [mschlieper@fpm.wsm-net.de](mailto:mschlieper@fpm.wsm-net.de)



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