



The pinnacle of gas purification

Dr Rob Grant FRSC, CEO at Gas Recovery and Recycle limited dropped in to PES to bring us up to date with on the latest for argon recycling, which they continue to refine. He is optimistic about the future and thinks a bounce back from the problems associated with Covid 19, is on the horizon. Currently, a new product is nearing the end of its development, which is aimed at recycling the ultra-high purity argon, where the impurity levels in the recycled argon are below 0.01ppm and nitrogen free!

PES: Hi Rob, it's a pleasure to talk with you as always. We have been following GR2L closely for some years now and you are regular participants in PES Solar/PV. To start with please could you give us a brief overview of your company?

Dr Rob Grant: GR2L was founded in 2008 to commercialise chemical looping combustive purification technology, developed in collaboration with Cambridge University, UK. This addresses the 10-10,000ppm impurity level gap not addressed by current conventional gas purification technologies

as seen, for example, in the microelectronics industry at the low ppm end and the general chemical processing industries at the top end of the gap.

We specialise in the recovery, purification and recycling of inert purge gases used in high value manufacturing industries such as solar PV, microelectronics and 3D metal additive manufacturing in the aerospace and medical markets.

Today GR2L's primary focus is on the photovoltaic industry for argon recycling,

which is used in very large quantities during the crystallisation of silicon into ingots, which is the first stage in the manufacture of silicon based solar cells.

In 2010 we entered into partnership with the British based UK Gas Technologies Group based near Gatwick, UK, to manufacture GR2L's flagship product, the ArgonØ™, and bring it to market. The UK Gas Technologies Group has a track record in high purity gas installations in the semiconductor and medical markets and is synergistic with GR2L.



Dr Rob Grant

PES: You continue to operate in several industries globally, currently, how important is solar/PV to you and with everything involving Covid-19 occurring during the last 6 months, how has your business changed?

RG: Historically, solar is by far our biggest market with business in Asia dominating and we continue to see growth for GR2L in the region. Every solar ingot production facility today uses high purity argon to purge the furnaces to maintain the purity and performance of the resulting silicon wafers.

However, the Covid-19 crisis has resulted in our solar customers pushing out investments, in both capacity and argon recycle, by 6-12 months and an oversupply of liquified air, from which argon is a by-product, is contributing to a downward trend in argon price.

In the West this effect is not as pronounced, due to the closure of a number of air separation units by the gas companies resulting in price increases for high purity argon and fuelling demand for argon recycle. Outside of solar we have seen a large increase in requests for quotations into the more general heat treatment markets.

PES: ArgonØ™ has been on the market for a while now; how does it work and have there been any developments and what continues to make it unique?

RG: The chemical looping combustive

purifier at the heart of the ArgonØ™ is unique to GR2L and patent protected. Plus, it delivers gas purities better than 0.5ppm. This enables GR2L to offer a compact, point of use, argon recycle system distributed across a facility that is easy to install, requires no additional process gases, is inherently multiply redundant and offers a factory recycle rate of typically 95-98% depending on the customer's process.

The equipment is easy to use requiring only minimal user intervention and ideal to retrofit to the 1,000s of furnaces already installed and producing ingots, as well as for new installations. The system recovers the furnace exhaust gas through a 3-port valve that diverts the exhaust from venting to atmosphere to being recovered by the ArgonØ™ for subsequent purification.

As a point of use system that connects to 3-6 furnaces, it allows customers to 'try before they buy' and verify the argon recycle rates in their own facilities before a wider factory roll-out. Competitor argon recycle systems tend to be large, single, centralised systems that also utilise additional process gases, such as hydrogen, and represent an 'all or nothing' approach to the client who is unable

to test them out before they commit to a factory wide installation.

Although at GR2L we have not stood still, making incremental improvements to the ArgonØ™ to improve its already world leading recycle rate and increase its purification performance to enable the unit to remove the excess levels of CO and hydrogen seen during the recharge process, which can hit 5,000 to 10,000ppm while increasing its immunity to air leaks in the vacuum lines, furnace particle filters and vacuum pumps. In addition, the ArgonØ™ can now allow for the gas purging of the vacuum pumps, without compromising the overall recycle rates or gas purity.

In addition, we have a new product nearing the end of its development, which is aimed at recycling the ultra-high purity argon associated with wafer manufacture for semiconductor devices and some high-performance solar wafers. Here the impurity levels in the recycled argon are below 0.01ppm and nitrogen free!

PES: Please can you explain how it is controlled and monitored and how is the collected data used?

RG: The ArgonØ™ is controlled by a PLC that takes input/output from all the system transducers and valves in the system. It controls the gas flow through the various reactors and automatically regenerates them based on the amount of gas that has been recycled. In addition, the PLC has

control links to the CZ Pullers to open and close the valves that recover the exhaust gas from the various Puller vacuum pumps and feed it into the main purifier unit. These can be discrete hardwired signals from the Puller, or via an ethernet connection between the ArgonØ™ PLC and the puller PLC. The ArgonØ™ PLCs are networked together and linked to a central SCADA PC system where all the systems parameters are monitored and recycle rates, as well as other key data, for an individual ArgonØ™ and at the site wide level are reported.

The SCADA PC is linked to the Internet providing GR2L engineers the ability to remotely support the ArgonØ™ systems throughout the warranty period. In addition, the SCADA PC is linked to The Cloud, through a secure data publisher, where it reports the key system data on a continuous basis using Aveva Insight. The Cloud based Insight software allows long term performance monitoring of the ArgonØ™'s average recycle rates, system regeneration frequency, key system temperatures and pressures. All are monitored and can be used to trigger e-mail alerts to both the customer and GR2L engineers if the data trend indicates an impending problem.

The Aveva Insight data can be collected into a dashboard view specific for each customer, who can log into the Cloud based application and view and download the performance reports as they choose. Within the 12 month warranty period all this remote system

monitoring is free of charge, outside the warranty period there is a small service charge for customers to continue to receive this valuable information.

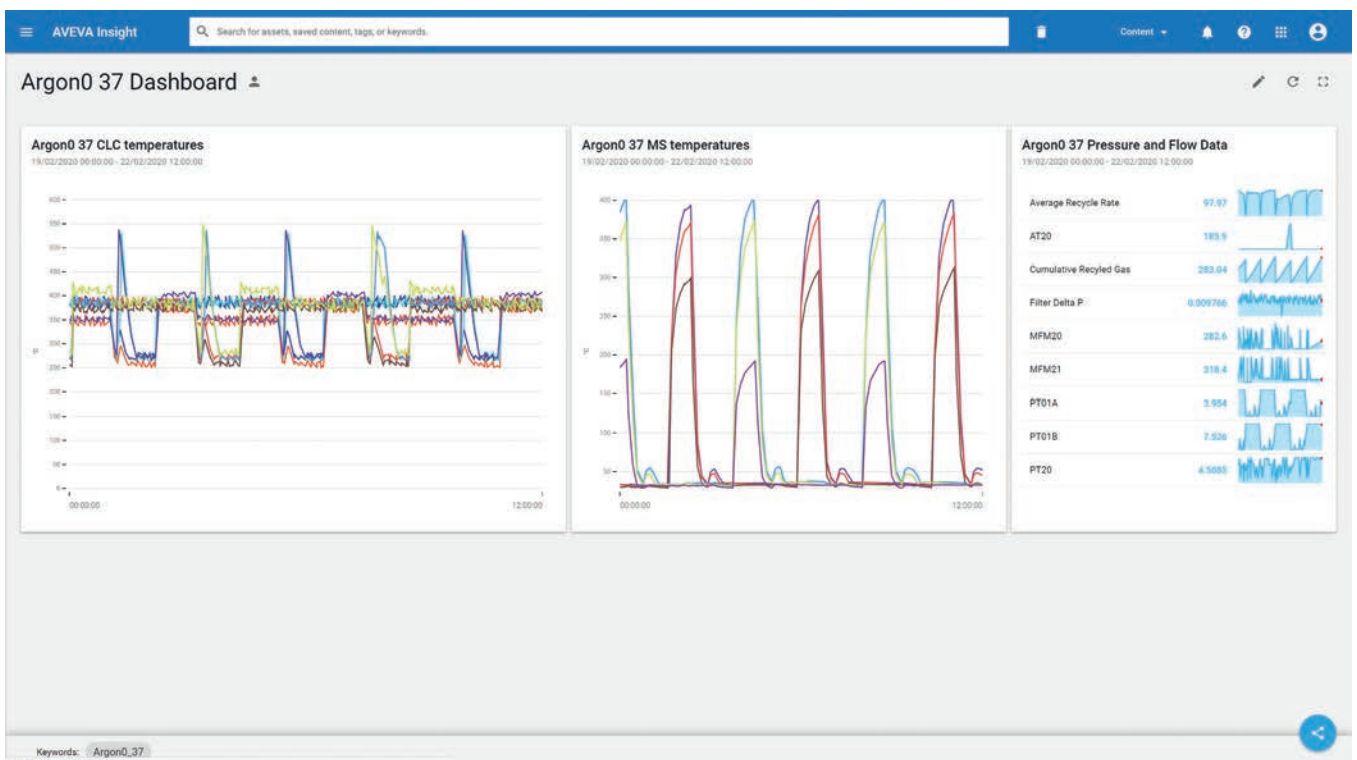
PES: Is this equipment easy to use, do you supply and fit and is special training required by the purchaser and what type of maintenance is needed once fitted?

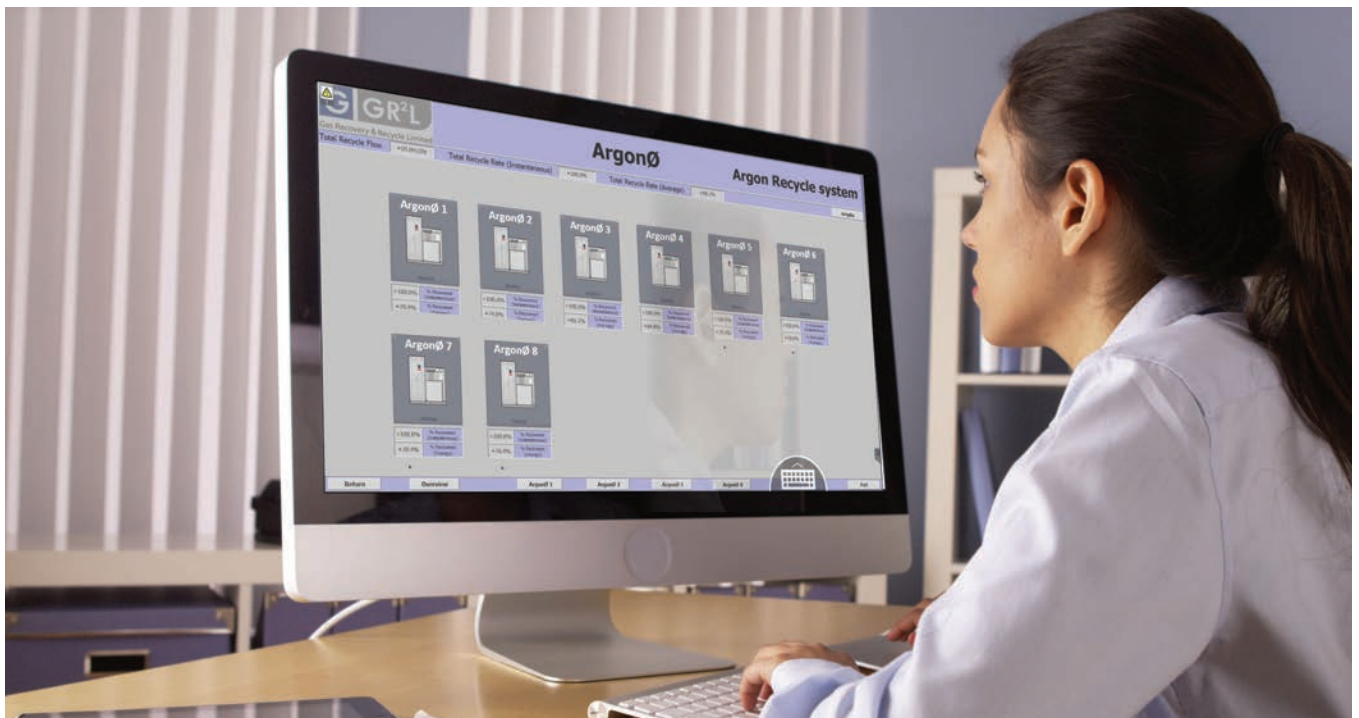
RG: GR2L works with each customer to ensure the optimal layout of the ArgonØ™ systems within their facility providing full installation drawings for the customer subcontractor to install the cabling and pipework.

After the installation services are complete GR2L will send in engineers to check things over and identify any snags – this ensures a trouble-free commissioning of the argon recycle systems. This usually takes place in the 8-12 weeks while the systems are in build and test.

Once the ArgonØ™ systems arrive onsite GR2L engineers will perform the hook-up, commission the systems and provide training for the customer engineers. It typically takes about 3 days to commission a cluster of 4 ArgonØ™ systems and argon recycle can start immediately. From a routine maintenance perspective there is very little to do except monitor and change a few particle filters and perform an annual service on the compressor.

PES: We would like to know about the





benefits to the end customer, in terms of cost savings and to the environment, taking into account the cost of the initial purchase price.

RG: Our customers see factory recycle rates of about 95 to 98% giving the systems a simple payback of between 18 and 30 months depending on the regional price of virgin argon. As an example, we have one installation, comprising 15 ArgonØs, recycling the argon purge gas from 60 CZ pullers with a facility recycle rate of between 96 and 98%.

This means the whole facility can be run with an average flow of only 125slm of a fresh, top-up, argon! In addition to the obvious cash benefit the ArgonØ™ system removes the toxic carbon monoxide gas impurity in the argon which can be as much as 5,000ppm during recharge and is otherwise just vented to atmosphere without any concern for the potential environmental impact this may have.

Also, by virtue of the significantly reduced argon deliveries there is a commensurate

reduction in diesel cyro-tanker mileage and emissions, without argon recycle a facility may have as many as 4-6 liquid tanker deliveries a day!

PES: GR2L, of course, is a global player, are there any particular geographical areas where you are looking to drive further growth in 2021 and what are you expecting to see for the solar/PV industry in general?

RG: Post Coronavirus the industries using large quantities of steel, for example ship building, automotive and construction, will take at least 2-3 years to bounce back and during that time the demand for liquified air will drop off; we are already seeing this in Northern Europe.

This will mean argon will move into a supply limited scenario and argon prices will go up. GR2L is ready and able to supply argon recycle systems, ArgonØ™, to allow the steady cost down trend in solar wafers to continue. While in the past GR2L has relied heavily on the Chinese market we expect to see demand pick up fastest outside China, particularly Northern Europe, where the argon prices will increase the most in the short term.

Whilst some investments have been postponed most are moving ahead again and this trend will accelerate. We predict a significant bounce-back in late 2020 early 2021 as the underlying requirements for clean energy are likely to be even larger than before the Coronavirus pandemic as nations adopt a greener energy agenda.



ArgonØ™ system

www.GR2L.co.uk