www.hhv.in

ISSUE 1 | VOLUME 2 | MONTH April | YEAR 2012

FOR INTERNAL CIRCULATION ONLY

HHV WORLD

• VACUUM EQUIPMENT • SPV EQUIPMENT • SPV MODULES • THIN FILMS & HOROLOGY

HHV marches ahead

It was a pleasant, inspiring sight to see the young faces of 650-750 members of the HHV family gathered on the Peenya factory lawn to celebrate the 48th foundation day of HHV on 10th April 2012.

The highlight of the year was the successful launch of the in-house designed automated 10 MW per year capacity single and multi-junction amorphous silicon (a-Si) solar photovoltaic module production line. It produces modules of 1m by1m, each of which can generate a stabilised power level of 60 peak Watts. The product won the Technovation Award 2011 from the Indian Semiconductor Association.

HHV's R & D center for development of SPV technology has earned the recognition of the Department of Science and Technology and Ministry of New and Renewable Energy of the Government of India. They have sanctioned projects proposed by HHV to carryout fundamental research in solar materials and to develop process and techniques to increase the efficiency of SPV modules. This core strength of HHV in developing indigenous technology for thin film coatings and materials has brought forth a composite working relationship with a number of scientific institutions like BESU, Kolkata, and the Technology Research Centre of RV College, Bangalore.

Other notable accomplishments of the past year have been the completion of major projects like the Rotary Vacuum Brazing Furnace for the Department of Space, the robotized TIG Welding System for HAL and automobile head / rear lamp coating equipment for M/s Valeo, for its production centres all over the world, like in Poland, India, China, Argentina, France etc.

Last year saw the successful expansion of our international business, led by HHV Limited, UK. It has received several orders for technologically advanced equipment and has supplied them to laboratories and industries in UK, Germany, Australia, Brazil USA, Germany etc. A landmark achievement in the export business is a recent order received from Russia for building of a large telescope mirror coating facility .

As the global recession recedes, HHV has started getting many enquiries from India and abroad which is a happy indicator of the future of the company.

INSIDE

Coater For Mirrors Of Large Telescopes

From ancient times India has been a leader in astronomy and Aryabhatta is a legendary name from those days.
After Independence, Professor Vainu Bappu had made outstanding contributions to Indian astronomy by setting up observatories in the country with modern telescopes.
Mirrors are the heart of optical telescopes. They need to be routinely re-coated since the reflective film of Aluminium or Silver or an alloy of both gets damaged and tarnished over time due to oxidation, dust, impact of charged particles from space etc.
This recoating has to be done under high vacuum and very controlled conditions, so that the deposit is spotlessly clean, highly accurate and very uniform. The deposition of the material is made using either sputtering or evaporation technology. In the case of large telescopes, the re-coating equipment needs to employ specially designed technologically advanced equipment for safely and accurately handling the heavy mirrors of large diameters. HHV is one of the few companies in the world with the capability of designing and developing such recoating equipment.

Expertise:
HHV made its first mirror re-coater for the telescope installed at the Hanle observatory of the Indian Institute of Astrophysics in the Ladakh region of the Himalayas, at a height of 4570 metres above sea-level. The mirror of the telescope has a dia. of2.1 metre and is 1 tonne in weight. Another re-coater with sputtering technology was made and supplied to the Inter University Centre for Astronomy and Astrophysics (IUCAA) for its large telescope installed at Girawali near Ghodegaon on the Pune-Mumbai high way at an altitude of 1000 metres above sea level. The

Mirror holding mechanism

concave mirror is 2.2 metre in dia., hasa thickness of 200mm and weighs 250 kg.

Large Telescope mirror coater:
And now, HHV has designed, developed and supplied a highly sophisticated, recoater with sputtering technology to the Aryabhatta Research Institute of Observational Sciences (ARIES) for their large telescope located at Devasthal near Nainital, at an altitude of 2500 meters above sea level. The mirror in this case is 3.7 diameter, 12mm thick and has a weight of 4.5 tonnes.
It was a challenging assignment since to handle this mirror during the coating process required a specially designed holder and manipulator and the recoated mirror had to have a surface accuracy of 1/16th of 5500 nano metres.
The mirror is positioned during the coating process on a special support called the Whiffle Tree mechanism. Arms from a central hub lead to three 9-point kinematic supports with soft pads on which the mirror rests during the recoating process. The location of these supports is critical since they have to take the weight of the mirror, while it is being rotated at around 3 to 5 RPM during the coating process. Since the mirror is quite thin, any small misplacement of the support will result in the mirror cracking. The mathematical technique of Finite Element Analysis is used to determine the optimal position of the mirror supports. The coating of the mirror is done in a vacuum chamber of 4 metres dia. and 1.7 metres height which is made up of two torrispherical dished ends. The inner surface of the chamber is suitably polished to minimise entrapment of any gases.
A 20 KW magnetron in the chamber is used to actually deposit the aluminium on to the mirror surface. The aluminium target of size 89mm (W) x 2000mm (L)and 6mm thick, having purity of

Top dished end moving mechanism

99.999%, is gripped by a water cooled holder.
The needed thickness of the film is achieved in about half an hour. Sensors are provided to check the coating thickness, reflectivity and uniformity.
The supply of this re-coater has been a triumph for the technological ingenuity of HHV's engineers.

Atmosphere controlled crystal growth furnace

This laboratory furnace is a versatile facility designed to develop various crystals and work with a variety of doping materials.

A graphite crucible is provided into which the raw material can be charged. The crucible can then be moved into the heating zone which utilises induction coils which can raise the zone temperature to 2500 degrees C.

An arrangement has been made to create a temperature gradient of 20 – 25 degree C for 6-8 hours. The temperature gradient facilitates the study of crystal growth at different temperature conditions and thereby allows tailoring of crystal properties to suit different applications.

The heating chamber consists of two quartz glass cylinders which are properly vacuum sealed at both the ends with suitable flanges. The inner one has a size of 200mm ID x 360mm (Ht.) and the outer one 235mm ID x 360mm (Ht.) with cooling water circulating between them. The metal container placed over heating chamber facilitates evacuation, gas inlet, measurement of temperature with pyrometer etc. A vacuum system has been attached to create an ultimate vacuum of 5 x 10^{-6} m.bar in 30 – 35 minutes. The operating vacuum is 8 – 7 x 10^{-6} m.bar at a temperature of 1600 degree C.

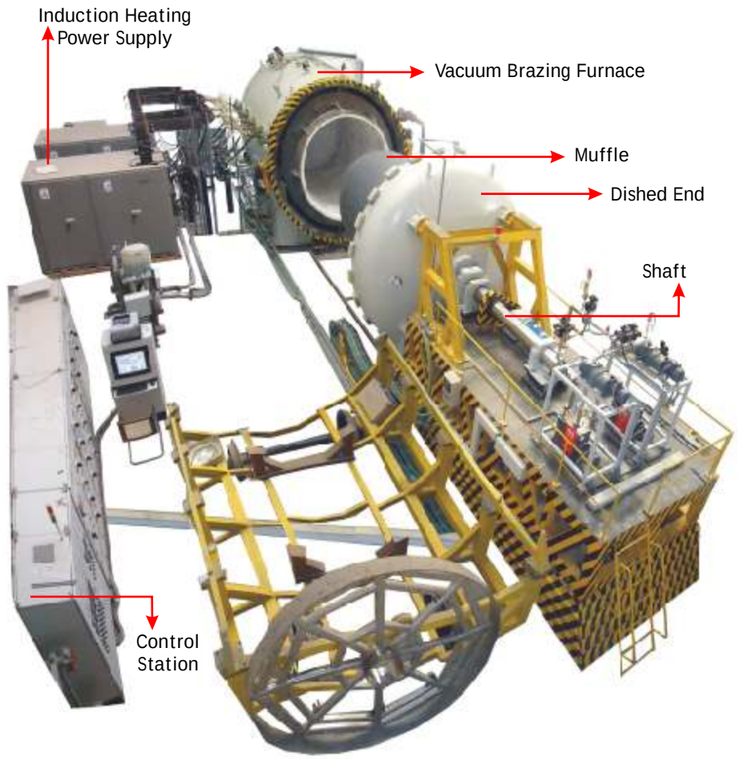
A computerized system with Supervisory Control and Data Acquisition Software (SCADA) provides continuous data logging of temperature readings from pyrometers and thermocouples, vacuum level, induction coil position and power input throughout the process.

High vacuum annealing furnace

HHV's totally automated controlled atmosphere furnaces are extensively used for heat treatment, brazing and other applications in modern industries and laboratories.

HHV recently supplied a horizontally mounted retort furnace which is used for annealing of Nickel, Titanium and Niobium based alloys. The retort is fabricated out of Inconel 600 material. The retort chamber has an inner diameter of 300mm and length of 6500 mm with thickness of 6mm. The chamber has 6 zones, each zone of size 1000mm in length. Nicrome 80/20 has been used as the heating element and is embedded in a semicircle and to ensure heat uniformity. The furnace has been provided with suitable insulation to ensure that the wall temperature does not exceed 5 degree C above ambient at maximum operation temperature of 800 degree C. The furnace has been designed for

continuous heating under vacuum and continuous cooling under natural/inert gas environment. A vacuum pumping system provided on either side of the collar to achieve a ultimate vacuum of 1 x 10^{-6} m.bar. It has an internal diameter of 300mm ID x 550mm cylindrical length and a copper coil is brazed on the collar for water circulation for effective cooling. A gas inlet system also facilitates filling the retort to a gas pressure of 800 m.bar pressure (abs.) to cool the job whenever required. This retort furnace has been provided with temperature controller, programmable logic controller (PLC), measuring and control instrumentation for total automation with safety systems to ensure full protection for the user.



Rotary Vacuum Brazing Furnace

HHV has been an active partner to India's aerospace sector in designing, developing and supplying a range of very sophisticated, technologically advanced vacuum technology based equipment for various applications. A couple of years ago HHV was given an opportunity by the Department of Space to build a technologically challenging, large size, automated rotary vacuum brazing furnace for its satellite launch vehicle programme.

The confidence of HHV to accept such a critical assignment came because of its earlier successful development of a small size (350mm diameter and a cylindrical length of 450mm) rotary vacuum brazing furnace with complete range of automation control and safety instrumentation for similar applications to a private customer.

Large Rotary Vacuum Brazing Furnace:

But the current assignment is not merely to build large size equipment with automation; it involves the tricky job of brazing a number of baffles in an annular space of a few millimetres between two identically formed, converging and diverging conical shapes. These baffles will act as internal guides in order to circulate cryogenic liquid at a high pressure and also cool the combustion chamber.

This particular brazing process requires special design to hold the nozzles/cones in place inside the furnace, create a vacuum in the annular space and apply positive pressure on external surfaces to ensure absolute contact with the baffles so that 100 per cent brazement is assured. During the brazing process, the job itself is rotated within the furnace in order to provide uniform heating and brazing.

The rotary vacuum brazing furnace in discussion has a large chamber with diameter of 3650mm and a cylindrical length of 4600 mm. The furnace is fitted with state-of-the-art instrumentation and a touch screen computer to enable operation in auto mode with SCADA.

A water-cooled copper induction coil embedded behind the refractory lining of this furnace provides the eddy current which heats the muffle which in turn heats the job. About 1.44 MW of connected power is needed for the process in which the temperature of the job attains a maximum of 1300 deg. C. The refractory lining comprises ceramic fibre boards made of a combination of alumina, silica and zirconia and vacuum formed into the shape of segments to form a conical shape.

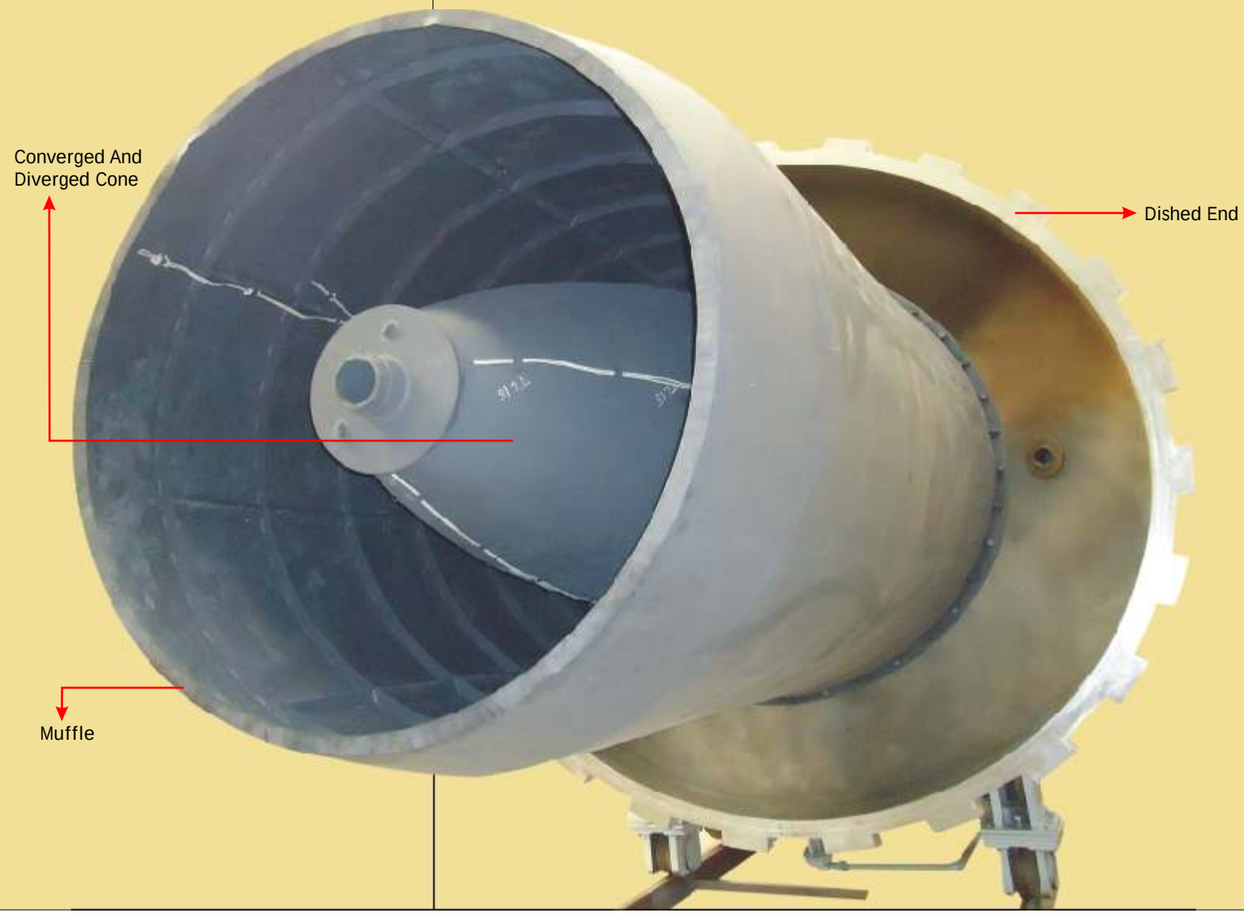
The job of size 2200 diameter mm x 2000 mm cylindrical length is enclosed

Small Size Vacuum Rotary Brazing Furnace

in a muffle mounted concentrically on the shaft which is fixed on the dished end. The shaft rotates the heated muffle and the job to ensure uniform brazing.

Rotary Vacuum Brazing:

After the job and muffle have been fixed on the shaft using the help of an overhead crane, the dished end is moved on rails to mate with the furnace



10 millibar vacuum while the annular space in the job is evacuated through two different vacuum pumping systems to a vacuum of 0.001 millibar via two ports previously welded to the job.

After the evacuation, the furnace chamber is filled with argon gas to 2.0 bars pressure. The function of the argon is twofold: one is to prevent any oxidation of the heated muffle and job outside the surfaces, and the second is to exert external pressure on the job surfaces being evacuated. This provides excellent banding of brazing on the inner and outer surfaces of the job.

The heating cycle is complex and consists of a series of steps involving ramping up the temperature and soaking for a predetermined time at and the whole system sealed. The whole furnace chamber is evacuated to different temperatures. Adequately

Control Station

placed thermocouples monitor the temperatures at 12 different positions along the length and circumference of the job with an accuracy of +/- 5 deg. C. These temperatures are constantly reported to a master controller which oversees the operation of 4 inverters involved in heating four different segments of the muffle. The master controller can be programmed for different heating cycles depending on the material to be brazed.

After the brazing is completed, a controlled cooling cycle initiates, using the same heated Argon gas as a media. The Argon gas is re-circulated in a closed loop through the job, through the heat exchanger and back again to the job. In this process the heat extracted from muffle and the job is removed in a water cooled heat exchanger.

Once the job has reached a particular low temperature the Argon gas is removed through the vacuum pumps and the furnace is exposed to the atmosphere. Then the shaft side of the furnace is uncoupled and shifted back on the rails so that the overhead crane can remove the muffle and the job.

This is the biggest and most sophisticated rotary vacuum brazing furnace facility in the country for brazing complex aerospace components.

Compact PECVD System for R & D

HHV offers flexible, high performance multi chamber cluster tool for precise control of processes suitable for research and development in MEMS/NEMS, Solid State Lighting, Renewable Energy, Nano Electronics, Photonics.

Recently, HHV has designed and developed a cluster type PECVD system for R&D purpose. It is compact, versatile, easy to operate, full of safety features, programmable, easy to maintain and, most important of all, affordable. The system comprises of one load lock chamber and four process chambers arranged in a circle with a transfer chamber at the centre. All the sub-systems involving gas control, pumping, evacuation, heating etc. are housed below with easy access via panel doors. Only the turbo pump for achieving higher vacuum is placed above the central exchange chamber. The whole system occupies only a 10 ft by 10 ft space.

The sequence of operations is fairly simple. The substrate is place manually in the loadlock chamber which is then sealed. After the system has been evacuated to the desired vacuum using rotary pumps, the substrate carrier is sent, using a magnetic arm, to the central transfer chamber from where it is transferred to the designated process chamber. The process chamber has the necessary RF (Radio Frequency) heating and gas inletvalves to facilitate deposition of the thin SPV film on the substrate. Thesubstrate is held in the carrier with itsface down so that any loose deposit just falls down.

After the deposition process is completed, the substrate carrier can be transferred, via the central transfer chamber, to another process chamber for some more deposition or back to the loadlock chamber for removal. The entire operation is monitored and controlled from a PC loaded with the necessary SCADA (Supervisory Control and Data Acquisition) software.

Highlights:

- Deposition of amorphous and microcrystalline silicon based doped, un-doped, and its alloy materials, Dielectrics, Metal Nitrides, Metal Oxides, Metals & Others
- Individual process chamber connected to central transfer / isolation chamber along with entry / exit load lock
- Substrate transfer: Magnetic / Robotic arm
- Substrate size: 100 mm to 150 mm
- Horizontal deposition
- Power source: MF/RF/ VHF/MW
- Substrate temperature up to 1000 deg C Residual gas analyse

Since the gases used , such as silane, can form explosive mixtures with oxygen, safety features involving evacuation, sealing, oxygen detection, stepwise controls etc. have been built into the system. All the equipment is made from stainless steel so that corrosion failures are avoided.

HHV Goes Global

A complete range of research tools for nanotechnology, laser ablation, critical optical coatings, forensic examination, laser mirrors, and electron microscopy on offer

Multi-purpose high vacuum deposition tool

Globalization and its challenges is the flavour of the day. To keep pace with the undergoing revolution of global business, initially HHV teamed up with established global players to serve the international scientific and industrial community by offering technologically advanced products at a competitive price. Today, HHV has reached a position of international technical competitiveness in the field of high value scientific equipment with its own brand.

It is gratifying to note that well reputed research and development centres and industries around the world have patronized HHV and this relationship is growing with a network of agents in United Kingdom, United States, Brazil, China, Australia, Germany, Sweden, Russia and many other countries.

The HHV brand has gone global with its thin film deposition equipment, not merely as a quality product but to meet the challenging needs for research in areas like nanotechnology, laser ablation, critical optical coatings, forensic examination, laser mirrors, electron microscopy, etc.

This expansion of HHV's overseas business has led the company to augment and upgrade its R&D, manpower and manufacturing resources. It has also given an opportunity to the company to prove its technological capability and strength by offering experienced based solutions for vacuum heat treatment and brazing furnaces, solar equipment,

Internal chamber view

Glove box with the deposition system for nano technology applications

physical vapour deposition (PVD) systems, etc. to international customers.

For instance, HHV has supplied technology advanced, totally automated, versatile, laboratory model deposition systems to M/s.Charleston, Singapore; M/s.Fundepes and M/s.Unsep of Brazil; Queensland University, Australia; and M/s.Schroder, Germany. Its large size thin film deposition system, suited for R&D labs as well as mass production, has been well received by industries like M/s Air Force USA and M/s UNSW, Australia. This model has five sputter sources, and the magnetron can be sequentially selected for both RF and DC sputtering. Co-sputtering is also possible by selection of two magnetrons for RF & DC sputtering respectively.

HHV's UK based business centre at London markets and extends its services and products. It is a well organized business centre, with highly experienced technical professionals having sound knowledge in these fields to serve the international market.

Despite present difficult economic times the potential for HHV's equipment in international markets is good and as the company expands its presence overseas the opportunities are expected to grow. In the medium to long term, HHV plans to grow its brand and become an established and major global player.

HHV at Bangalore Nano

HHV showcased its wide range of thin film deposition systems, which can be used to produce nano particles, wires, tubes, film and so on, at the 4th Nano Science and Technology Exhibition held at Bangalore, Dec 8th & 9th, 2011. The HHV stall drew a large crowd, as can be seen from the photograph.

48th Foundation Day Celebrated

HHV celebrated its 48th foundation day on 10th April 2012. The foundation day is jointly celebrated by the management and employees along with their family members.

The function started with the traditional lighting of a lamp & prayer. The company directors presented the annual report for the previous year which was enthusiastically received. HHV has weathered the global recession and unbalanced global economy reasonably well and is moving forward. This was possible because of its technological strength, internationally accepted quality and the courage to develop new products in-line with the market scenario. The manufacturing heads presented the performance of the previous year and projections for the next.

Mr. S.V Narasaiah - Chairman, in a visionary speech, recollected the initial constraints to establish and develop the company in 1960s with the objective of developing vacuum technology indigenously & making India self reliant in that field. Today

the company is growing in the same direction & spirit with the encouragement of scientists, institutions and employees and has become a leading global competitor in vacuum science and photovoltaic technology.

The meeting ended with distribution of awards to the best performers and everyone pledged to work together to achieve the new set of targets.

HHV honoured with Technovation Award 2011 by ISA

Mr. Prasanth Sakhamuri - Managing Director receiving the award from Mr. M N Vidyashankar, Secretary IT, Karnataka

Hind High Vacuum Company Private Limited (HHV) has won the Indian Semiconductor Association's coveted Technovation Award 2011 for indigenously developing an automated line for high volume production of 1 m by 1m amorphous silicon thin film solar photovoltaic modules. The capacity of the line is 10 MW per year. The outstanding technical design & novel processes employed in HHV's system make it much more cost effective than other such lines available abroad. India Semiconductor Association (ISA) is the premier trade body representing the Indian Electronic System Design and Manufacturing (ESDM) industry. It has over 150 members - both domestic and multinational enterprises. ISA is committed towards building global and supporting its growth through focused initiatives in developing the ecosystem. ISA works closely with the governments, in the Centre & the states, as a knowledge partner of the sector.

The conversion of sunlight into electricity is one of the most promising renewable energy options for India which receives a high level of sunlight throughout the year over most of its area. There are two commercially prevalent methods used throughout the world for achieving this conversion. One uses thick panels of crystalline material such as crystalline silicon and the other utilizes thin films of material such as amorphous silicon deposited on a substrate.

Thin film solar photovoltaic panel production involves very complex technology & HHV is the only company in India which has mastered it, under the guidance of Professor A.K.Barua of the Indian Association of Cultivation of Science (Calcutta) who is a leading light in India in solar photovoltaics.

Steps are now being taken at HHV's research lab for solar photovoltaics to further bring down the cost of thin film SPV panels by developing high efficiency next generation tandem cells combining microcrystalline technology

Chairman, Sri S.V.Narsiah along with Managing Directors Prasanth Sakhamuri and Nagarjun Sakhamuri, honour Professor A.K.Barua for his support to SPV technology development at HHV

Rotary Pioneer Award 2012

Shree S.V Narasaiah, Chairman of HHV receives Rotary Pioneer Award 2012 from Rotary Bangalore Down Town on 20th April 2012. It is in recognition of his pioneering efforts to make the country self reliant in vacuum science and photovoltaic technology.

Hind High Vacuum Co. (P) Ltd.
Site No.17, Phase 1, Peenya Industrial Area, Bangalore 560 058, India.
Ph: +91 80 41931000. Fax: +91 80 28394874. Email: info@hhv.in
Web: www.hhv.in