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12.2020

ERMAKSAN
INNOVATIVE TECHNOLOGIES

ENAVISION POWDER REACTOR PR-2000 SYSTEM DETAILED FEATURES

1. General Overview of the Powder Production

1.1. Process Description

AHB Tooling & Machinery and Ermaksan are pleased to offer the Enavision PR-2000 metal powder Gas Atomization system. Gas Atomization Systems are the the most common and efficient way to produce metallic powders.

In this method metal alloys (alloy melting temperature is below 1500° C) are melted by the melting crucible in the melting chamber of the gas atomization system. Once the metal alloys are melted, the melting chamber is tilted with a servo motor and joystick-controlled system which allow the melted alloy to enter in, and pass through the atomization portion of the system. Atomization of the liquid metal is processed through powerful gas jets / nozzle which is located under the Tundish Crucible.

As the metal droplets fall through the atomization tower the metal droplets become spherical, cool down and solidify into metal powder.

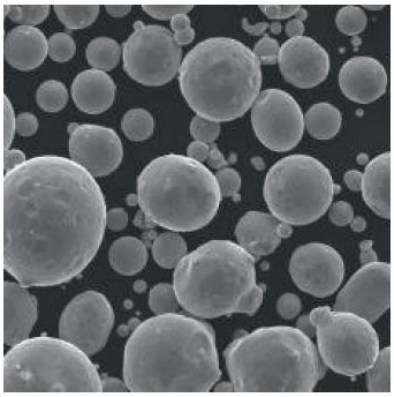
The cyclonic metal powder unit separates out any larger parts of metal powder and the metal powder is collected inside the powder collection unit.

The sieving unit / air classifier allows for screening for a variety of different metal powder sizes for different application use such as; Selective Laser Melting (SLM), Electron Beam Melting (EBM) and more.

1.2. Application Areas

- VIGA gas atomization system is used to cerate:
  - Powder production of non-reactive materials
  - Powder production from metal/metal alloy chips
  - Powder production from metal alloys (dimensions of the alloys should be considered for sizing to be inserted into the melting crucible)

- Produced Powders can be used for the following applications:
  - Selective Laser Melting process - Typical powders are d10: 20 µm, d50: 25-35 µm; d90: 53 µm.
  - Electron Beam Melting process - Typical powders are d10: 45 µm, d50: -35 µm; d90 : 53 µm.
  - Coating Processes.
- Producible potential powders:
  - Steel alloys - Automotive, construction, custom design production, marine, tooling and various applications
  - Inconel alloys - High temperature required applications like turbine blades for energy production
  - CoCr alloys - dental and aviation applications
  - Tool steel alloys - molding application



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2. ENAVISION POWDER REACTOR 2000 SYSTEM CONFIGURATION AND INTEGRATED FEATURES

2.1. Technical Specifications

Ermaksan Gas Atomization system has been developed to produce metallic powders from the raw metallic alloys and chips.

Model name	Enavision PR 2000
Typical Installation Area / footprint	60 x 65 ft
Atomization System Height	53 -60ft
Max. Melting Capacity *	4500 lbs.
Max. Melting Temperature	3000 °F
Melting System	Induction Furnace
Inert Gas	Liquid Argon; recommended purity %99,995
Time to reach safe O_2 content	≤ max. 2 hours (for %0,4 O_2 level)
Typical Melting Time	2—3 hours
Typical Atomization Cycle	150-180 minutes
Total Process Time	≤ 8 hours
Cooling Cycle	4-6 hours
** Typical Annual Production Capacity	580 USTONS
Typical D50 Range	20- 120 µm
Operating system	Windows 10/X embedded
Network	Ethernet / Ethercat
E. connection /Power input	400V 3Ph/N/PE ,50/60 Hz,
Typical Inert gas consumption during a cycle	≤ 6,5 - 10 US Tons
*calculated according to In 718	
** 5 days/week , total 260 days of production a year	

- Minimum installation area : 60 x 65 ft
- Atomization tower high : 53 -60ft
- Production/melting capacity : 4500 lbs.
- Maximum temperature : 3000 °F
- Melting system :
  - Melting Generator Type : Induction
  - Melting induction power : 800 kW,
  - Melting İnduction frequency : 500 Hz
  - Melting Time : 2 – 3 hours

- Tundish System
  - Tundish Generator Type : Induction
  - Tundish Induction Power : 60 kW,
  - Tundish Induction Frequency : 10 - 60 kHz
  - Tundish Crucible : Ø 400 mm – 460 mm
  - Max. Tundish Temperature : 2300 – 2650 °F
  - Tundish Heating Time : 2 hours
- E. connection /Power input : 400V 3Ph/N/PE ,50/60 Hz,
- Inert Gas : Ar; purity %99,995 or higher,
- Inert gas type : liquid
- Operating system : Windows 10/X embedded
- Network : Ethernet / Ethercat
- O_2 level (during process) : 0,025 – 0,04%
- Time to reach safe O_2 content : ≤ max. 2 hours (for %2 O_2 level)
- Inert gas consumption (one cycle) : ≤ 6,5 - 10 US Tons
- RAL color code : RAL 5002 or equivalent

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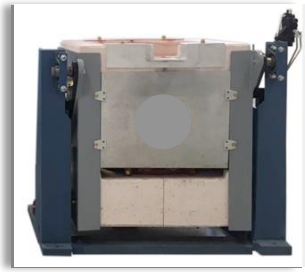
2.2. Melting Chamber

The Melting Chamber consist of the melting crucible, tundish crucible and the melting crucible rotation system. Before the melting process begins, the oxygen level will need to be decreased to .04% using 99.995% Argon. The semi-automatic control system is also used to reduce the atmosphere in the inside the melting chamber, and atomization tower.
Atmospheric conditions generally can be established in a period of about two hours time depending on the purity of the gas provided by the supplier.

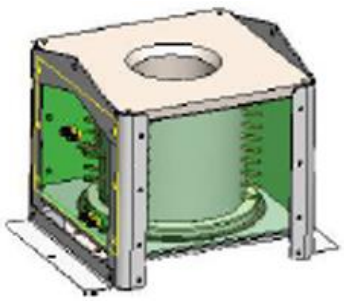
2.2.1.Melting Crucible



- Melting Crucible Temperature: Max 3000 °F
- Melting Crucible Capacity : max. 4500 lbs.
- Heating system : Induction
- Induction Furnace
  - Electrical Connection : 400V 3Ph/N/PE ,50/60 Hz
  - Coil : 34" OD x 34" HT
  - Generator : 800 kW
  - Frequency : 500 Hz
  - Earth connection : ≤ 0,25 Ohm
  - Induction furnace
- Melting Time : ≤ 3 hours
- Min. capacity : % 30 of full capacity; 1400 lbs.

Induction Generator

2.2.2. Tundish Crucible



- Tundish Generator Type : Induction
- Tundish Induction Power : 60 kW,
- Tundish Induction Frequency : 10 - 60 kHz
- Tundish Crucible : Ø 400 mm – 460 mm
- Max. Tundish Temprature : 2300 – 2650 °F
- Tundish Heating Time : 2 hours
- Capacity : 330 lbs

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2.3. Control System

- Industrial Process Control : Beckhoff
- Processor : Intel i5 2,4 GHz or equivalent
- Ram : 4 GB DDR3L
- Operating system : Windows 10 Embedded
- PLC : TwinCat 3
- Motion Control : TwinCat 3 NC PTP
- Screen : 14.5 inch, multi touch, 1920x1080,
- Communication port : USB, Ethernet
- Memory : 300 GB

2.4. Chiller Unit

Enavision Powder Reactor 2000 has 3 chiller units.

Chiller 1 for Atomization tower frame cooling system.

Chiller 2 for Induction system/coil of the Melting Crucible

Chiller 3 for the Induction system /coil of the Tundish Crucible

- Scroll Compressor - Reduces compression to increase part-load efficiencies
- Fans - Aluminum blades, asynchronous external motor, IP 54
- Condenser - Gold epoxy coated or micro channel condenser technology
- Evaporator- High efficiency shell & tube or stainless-steel plate type
- Hydronic Module - Pump and insulated buffer tank, factory assembled
- Controls - Staging compressor and fan logic, adaptive to high-low temperature
- Durability - Anodized aluminum and powder-coated components

Cooling Capacity	160.000 kcal/ h
Max. Power Requirement	30.6 kw
Max. Pressure	3.4 bar
Max. Flow	7,5 kW
Deionized water capacity	350 liters
Inlet-Outlet Connection	3" – 2 ½"

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2.5. Atomization Tower

- Body Frame : Stainless Steel
- Body Frame : Sectioned (for easy setup and cleaning)
- Body Frame : Two walls for cooling
- Total Height : 30-36 ft
- Required are : 26 x 33 ft
- Over pres. protection: valve & electronic
- Platform : 2 floors
- Assembly plan : provided prior to system delivery
- Cyclone unit : connected to tower and suction unit
- Cooling Pipe : with PPRC (Polypropylene Random Copolymers) convenient with DIN 8077, DIN 8078, DVGW W544
- Vacuum pump : system pressure decreased 0.8 – 0.7 bar during the process

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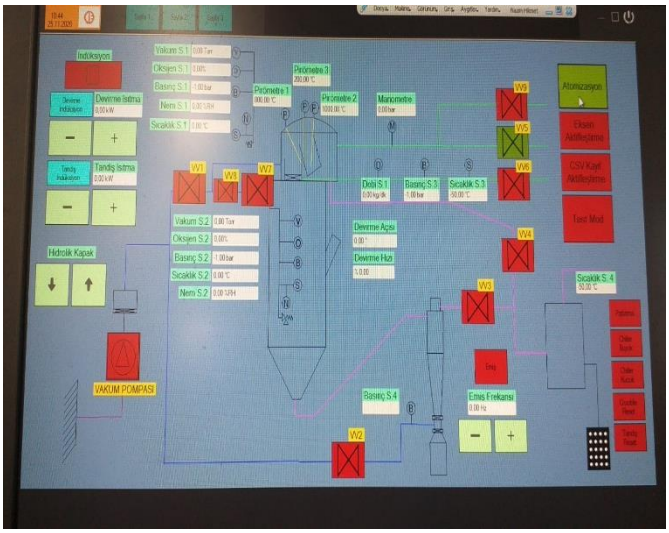
2.6. Ermaksan Extraction Filter Unit

The Extraction Filter Unit is connected to the cyclone unit. Produced metal powders are conveyed from the atomization tower to the powder collection bin. Used inert gas is deposited to the atmosphere over passing through the 1 µm filter unit inside the suction unit.

- Flow Rate : max 10000 m³/h
- Motor : 11 Kw
- Control : Frequency control over the control panel
- NOISE LEVEL : 72 dB
- Electricity Connection: 400V, 3Ph/N/PE ,50/60 Hz
- Weight : 1200 kg
- Filter Unit : 12 pieces, 1 µm
- Filter Cleaning : Semi-Automatic

2.7. Process Control Sensors

The PR-2000 requires a period of about 2 hours of start-up time prior to feeding metals/metal alloys into the PR-2000 System.
The Enavision PR-2000 is configured with different sensor technologies to guarantee the process cycle each time the system is run. Process Control Sensors are located in the crucible sections as well as the atomization tower as detailed below.
System critical sensors are redundant for safety purposes.



- **Oxygen Sensor 1**: On the melting chamber "% level to 1 ppm" level controls the oxygen concentration and gives real time feedback to the control unit
- **Oxygen Sensor 2:** On the atomization tower "% level to 1 ppm level" controls the oxygen concentration and gives real time feedback to the control unit
- **Vacuum Sensor 1:** Controls the negative pressure inside the build chamber
- **Vacuum Sensor 2:** Controls the negative pressure inside the atomization tower
- **Temperature Sensor 1:** Controls the melting chamber temperature and gives real time feedback to the control unit
- **Temperature Sensor 2:** Controls the atomization tower temperature and gives real time feedback to the control unit
- **Temperature Sensor 3:** Controls the inlet inert gas temperature and gives real time feedback to the control unit
- **Pressure Sensor 1:** controls positive to negative pressure changes inside the melting chamber and gives real time feedback to the control unit
- **Pressure Sensor 2:** controls positive to negative pressure changes inside the atomization tower and gives real time feedback to the control unit

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- **Pressure Sensor 3:** controls positive pressure changes on the inlet inert gas and gives real time feedback to the control unit
- **Pressure Sensor 4:** controls positive to negative pressure changes inside the cyclone and gives real time feedback to the control unit
- **Humidity Sensor 1:** controls the humidity level changes inside the melting chamber and gives real time feedback to the control unit
- **Humidity Sensor 2:** controls the humidity level changes inside the atomization tower and gives real time feedback to the control unit
- **Pyrometer 1:** controls the temperature changes on the tundish crucible and gives real time feedback to the control unit
- **Pyrometer 2:** controls the temperature changes on the melting crucible and gives real time feedback to the control unit
- **Pyrometer 3:** controls the temperature changes on the melting crucible and gives real time feedback to the control unit
- **Camera 1:** Allow the view of tundish crucible
- **Camera 2:** Allows the view of the tilting operation of the melting crucible
- **Camera 3:** Allows the view of the atomization process

2.8. Electrical Panel

The Electrical Panel consists of a DC power supply unit, control I/O modules, Safety PLC, circuit breakers, contacts and relays. All system and electrical panel are configured to safety system regulation standards.

- Aluminum platform for Al based powders
- Steel platform for all other powders

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2.9. Sieving System

The included Semi-Automatic Sieve Station will provide high quality powder sizing. The Sieving Station has been designed to provide optimum sieving efficiency, ensuring your powder is ready for use or reuse when required. A system is designed with a simple one-button operation and is designed to be mobile. The automated check screener ensures your powder at every stage of the process is qualified for use quickly and safely.

The Ermaksan Enavision PR-2000 VIGA system has a capacity of up to 440 lbs/hr. AHB/Ermaksan can provide many different types of different sized packaging systems as required for final packaging of powders. Final packaging systems will need to be discussed and agreed upon by the customer and AHB prior to acceptance of an order of the system.

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3. Warranty & Installation, Training, Service

Warranty, Installation, Training, Service	
Specifications Offered	
Warranty Term	12 months from date of installation of the ENAVISION PR-2000 System The installation will begin within 10 weeks of the machine clearing customs. (Due to global pandemic and local/federal government restrictions, there may be unpredicted delays with/without notice). In case of earlier installation, the installation date will be considered as a start of warranty period. The warranty is limited to replacing parts found to be defective. Consumable items are not included in warranty terms. Ermaksan reserves the right to invoice service visits found to be necessary due to misuse of the machine or lack of maintenance. The responsibility of ERMAKSAN is limited to the clause here above. This limitation excludes liability for indirect damages which include loss of production, turnover or profits.
Response time	Ermaksan will provide remote support (via telephone, email and/or remote connection to the machine), if the problem cannot be resolved remotely, Ermaksan guarantees on-site response time within 24 to 48 hrs during the 12 month Warranty Period. (Due to global pandemic and local/federal government restrictions, there may be unpredicted delays with/without notice)
Repair time	Repair time of components will not exceed 30 calendar days from the receipt of the malfunctioning equipment during 12 month contractual warranty period. If during 30 calendar days, the component is deemed to be unrepairable and is not the fault of the operator, the corresponding functional item/part will be provided within a period of 30 calendar days, until malfunctioning equipment is repaired. (Due to global pandemic and local/federal government restrictions, there may be unpredicted delays with/without notice).
Availability of spare parts, consumables	Ermaksan guarantees that it will provide availability of spare parts and consumables for a minimum period 5 years after provisional acceptance.
Installation & Basic Training	Installation & Basic Training service will be provided by Ermaksan Engineers and is included in the quoted price of the system. Installation time is planned for 6 weeks. Training is planned for 1 week. Online support and training will be provided by Ermaksan without any extra charge during the 12 month warranty period as requested by the customer.

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