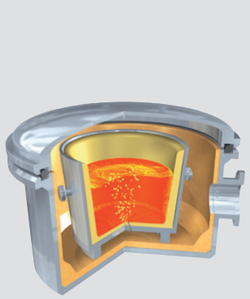
Innovative vacuum solutions

for secondary metallurgy steel degassing

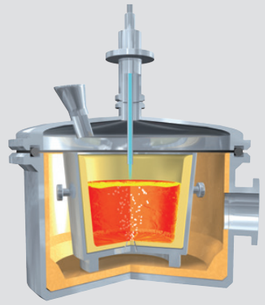
Utmost efficiency through vacuum

VD / VOD processes

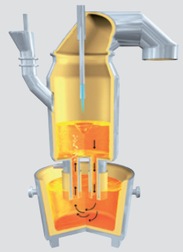
Vacuum Degassing (VD) for low alloy steels; Vacuum Oxygen Decarburising (VOD) for stainless steels. VD treatment is used to reduce the volatile gas content (e.g. hydrogen, oxygen, nitrogen) of the steel to enhance the steels capabilities. VOD treatment involves an additional oxygen blowing step for carbon removal. Oxygen blowing is also used for decarburising unalloyed or low alloyed grades (VD-OB) and for chemical heating.



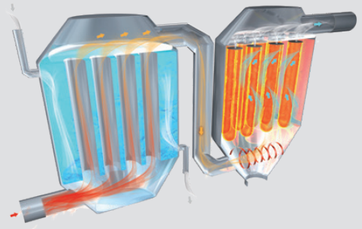
VD Vacuum Degassing



VOD Vacuum Oxygen Decarburization



RH Vacuum Circulation



Typical Cooler / Filter combination

RH-O (Ruhrstahl Heraeus) process:

Ideal for integrated steel plants or high productivity installations with frequent vacuum treatments in rapid sequences. Degassing and decarburisation is more effective than in ladle and tank degassing (VD) thanks to a more intensive use of argon and a much larger freeboard of the reaction vessel. In a RH-system the lower end of the vacuum vessel bears two snorkels, which are immersed into the ladle bearing the steel bath. By evacuation of the vessel, the steel is lifted up into the treatment chamber.

Challenges to the Vacuum System

VD process

- The vacuum system must handle the complete gas-flow and the significant amount of dust, created by metal vapors of the melt
- Typical suction speed demand at the degassing pressure (~0.67 mbar) is between 50,000 m^3/h to 250,000 m^3/h
- Required evacuation time: approximately 4-6 min. Fast evacuation is important, as the melt is continuously cooling down during the treatment. To avoid slag-foaming and heavy gas outbursts and splashing, a controlled pump-down process is all necessary

VOD process

- Decarburization requires a vacuum system which is able to operate continuously in a rough pressure range of approximately 50-200 mbar, while simultaneously removing high gas flows of typically 5,000 m^3/h to 20,000 m^3/h
- The vacuum system must be able to withstand gas-flow peaks with high concentrations of gaseous oxygen

Challenges to the Vacuum System

RH / RH-OB (Ruhrstahl Heraeus) process

- Process challenges are similar to VD and VOD. As tonnages are higher and as the protection of the oxygen lance requires huge amount of additional inert gas flow, the typical suction speed demand at the degassing pressure (~0.67 mbar) can go up to >1,000,000 m^3/h

Gas cooling

- Duing all forced decarburisation processes with oxygen blowing the vacuum system needs to operate long time in a rough pressure range
- An efficient gas-cooling is necessary as the extracted hot gases would otherwise overheat the filter and vacuum system

Dust filtration

- Dust filtration is required to trap the partly huge amounts of dust created during the process
- As the dust particles are often pyrophoric, the filtration system must be designed accordingly

Vacuum systems for efficient steel degassing

Leybold provides you innovative vacuum solutions for secondary metallurgy applications. Benefit from our long time experience, more than 100 systems in the field, being a worldwide leading supplier for tailor-made concepts based on customer demands.

State-of-the-art mechanical pumps employ a very reliable design, enabling the pumps to survive inside the rough steel plant environment. By installing standard pumps in multiple arrangements, even highest suction speed requirements can be fulfilled at a competitive pricing.

6-2-2 system configuration

Mix and match...

Today, mechanical vacuum systems combining Roots blowers and dry screw vacuum pumps are the accepted industrial standard. These modern mechanical pump solutions help to reduce operating costs and CO_2 emissions while providing new process control possibilities at the same time. Leybold provides highly standardized solutions for steel degassing systems.

Standard vacuum components are produced in high numbers, thereby offering low cost, fast availability and highest quality, ensured by stringent production standards according to ISO9001. Our pumps can be repaired on site by trained service people. A back-up pool with pumps is available in many locations worldwide in case field service is not applicable.

DRYVAC Vacuum Pumps

DRYVAC dry screw type vacuum pumps are rugged and compact vacuum solutions with integrated smart monitoring and control functions. They are ideally suited for demanding industrial applications. Pumping speed: 450 to 1600 m^3/h.

8-2-4 system configuration (ATEX)

RUVAC WH Roots Blowers

RUVAC WH Roots pumps attain high pumping speed and best ultimate pressure with maximum safety in modern industrial applications. The smart design of the pumps combines highest robustness with the most compact roots pump design on the market. Operation with frequency converter optimizes the power consumption and protects the Roots pump against thermal overloads. Pumping speed: variable from 720 to 9,800 m^3/h (with frequency converter).

...the right system for your requirements!

The idea behind

Process-adapted control system

Smart system control

Leybold offers various options to simplify process system control and monitoring to optimize performance and user convenience:

- Control and data acquisition of system parameters via digital I/O interfaces or bus systems as Ethernet, Profibus, RS 232, WiFi, GSM, for example
- Simple digital display via touch panel up to visualization on mobile devices via app, including remote access

Our portfolio includes the implementation of custom software programming.

Our system solutions

Two standard products are optimally combined into standardized skids. To reach the optimal combination of highest suction speed and lowest power consumption, a three stage system design is applied. According to a “building block concept”, each skid can be individually designed and optimized according to the specific suction speed and pump-down requirements of the specific degassing process.

Flexible system design:

- **First stage:** 2-4 DRYVAC DV 1200/1600 as backing pumps for fast pump down
- **Second stage:** 2 parallel RUVAC WH 7000 roots blowers for energy efficient compression
- **Third stage:** 4-8 parallel RUVAC WH 7000 roots blowers for high suction speed at low pressure

This combination provides nominal suction speeds from 39,200 m^3/h to maximum 78,400 m^3/h. The concept also allows extension of the skids at any time in case of a change in requirements. Depending on the specific demand of the individual steel degasser, Leybold designs solutions out of one or several parallel skids. The special design of using parallel pumps on each skid ensures highest uptime of the system even in case of a single pump failure. The failed pump can be automatically valved off and the degassing process can continue with only a small capacity loss. Any pump can be exchanged by the user in less than 1 hour.

10-2-3 system configuration special customer demand

Your benefits

System solutions advantages

- Mechanical vacuum systems from Leybold offer a “push-button” availability, without power consuming stand-by operation
- Guaranteed suction speed and pump-out time
- Fastest availability of optimized systems and standard products on the market
- Easy extendable, prepared for later extensions
- Most compact solution with lowest noise emission
- Minimized total cost of ownership. Our pumps and systems are optimized for lowest power consumption as standard
- Optional electrical cabinet including software (plug and go)
- Programmed evacuation ramps and utilizing the variable rotary speed of the pumps in combination with off-gas recycling prevent slag foaming
- Optional bypass possible
- Uncomplicated to transport, the system can be split in 3 parts only and fits into a standard container
- Quick installation on site
- Highest uptime due to redundancy valve concept
- User-friendly service, single pump exchange in < 1 hour
- ATEX Cat. 2 certified versions available for systems
- Worldwide after-sales support by the unique Leybold Service network

ATEX

Risk assessment under vacuum

Explosion protection safety concept

Degassers in vacuum systems, particularly those using oxygen injection such as VD-OB, VOD and RHO, may result in off-gases containing flammable gases such as carbon monoxide (CO) or Hydrogen (H2) which are potentially explosive during a limited period of the degassing cycle. The user must ensure that these cannot cause a hazardous explosion if ignited by a potential ignition source. The use of an ATEX certified mechanical vacuum system effectively solves this problem. By using ATEX certified systems, the user can ensure highest safety levels for the protection of employees for a minor additional investment only. Leybold can offer fully ATEX certified systems for your specific application involved in handling of such explosive gas mixtures.

Typical system design consisting of **RUVAC** WH 7000 roots blowers and **DRYVAC** DV 1200 dry vacuum pumps. The systems can easily be upgraded for higher demands or specific pump out time requirements, e.g. by additional **DRYVAC** DV 1200 in the 1st stage.

VD melt size [t]	Typical VD mass flow [kg/h]*	Effective pumping speed @ 0.67 mbar [m^3/h]	No. of modules	Typical system configuration		
				No. WH 3rd stage	No. WH 2nd stage	No. DV 1st stage
Example for smaller melts with one system module:						
30	30	37,600	1	5	2	2
35	35	43,900	1	6	2	2
40	40	50,100	1	7	2	2
45	45	56,400	1	8	2	2
Example for bigger melts with parallel system modules:						
75	75	94,000	2	7	2	2
100	100	125,300	3	6	2	2
130	130	163,000	3	8	2	2

* The mentioned mass flow data is a representative value which can deviate depending on system layout and process details.

Operation costs calculation example:
Steam Ejectors vs Mechanical System
Degasser type: 80t VD, 2 systems 8-2-2 configuration
Heats: 80 heats/day
Utilization: 280 days/year
Annual production: 448,000 t

Type of Vacuum System:	Steam Ejector	Dry Mechanical
Expenses:		
Energy	4,032,000 €	982,600 €
Maintenance and spares	54,700 €	8,100 €
Total costs per year:	**4,086,700 €**	**990,700 €**
Annual saving		**3,096,000 €** **Ø 6.91 €/t**

Leybold

Pioneering products. Passionately applied.