VA 1: Future Requirements on Vacuum Pumps and Vacuum Gauges

Time: Monday 10:00–11:20 Location: HFT-FT 131

Invited Talk VA 1.1 Mon 10:00 HFT-FT 131

Current Techniques and Challenges in the Design of Vacuum Pumps — •Magnus Janicki — Oerlikon Leybold Vacuum, Bonner Str. 498, 50968 Köln

The industrial design of vacuum pumps in general tries to optimize the vacuum performance and the energy efficiency of newly developed pumps in the limits of mechanical, thermal and financial possibilities. Different simulation techniques are used to find the optimum design parameters prior to the prototype testing.

In most vacuum pumps all three flow regimes, the viscous, the Knudsen and the molecular flow are to be found simultaneously at different locations. As most flow models show good accuracy only in a specific flow regime, the calculation of the vacuum performance of the integral pump is often not covered by a single simulation model. While CFD methods are very useful in the viscous flow regime, their accuracy decreases when the flow enters the Knudsen flow regime. Monte Carlo methods on the other side are very helpful in calculating molecular flow but become computationally intensive with higher gas pressures due to the necessity of high particle numbers and the inclusion of collisions between the particles. Additionally there are nearly no commercial tools to calculate the flow of rarefied gases in three dimensional geometries.

This talk gives an overview of simulation models that are used in the industrial design of vacuum pumps, especially with screw vacuum pumps, roots blowers and turbo molecular pumps. It is shown, how far these techniques help during the development process of new pumps and where their simulation capabilities are limited.

VA 1.2 Mon 10:40 HFT-FT 131

Fusionskraftwerke - Anforderungen und gegenwärtige technische Entwicklungen der Vakuumpumpsysteme — •Thomas Giegerich und Christian Day — Institut für Technische Physik (ITEP), Karlsruher Institut für Technologie (KIT), Campus Nord, Eggenstein-Leopoldshafen, D-76344, GERMANY

Die Entwicklung zukünftiger Fusionskraftwerke stellt besondere Herausforderungen an deren Vakuumsysteme einschließlich der Vakuumpumpen und der Abgasaufbereitung.

Hochverfügbare, zuverlässige und ökonomische Pumpen werden benötigt, um einen Druckbereich von <10-7 bis 1000 mbar abzudecken. Dabei müssen unter rauen Einsatzbedingungen (hohe Temperaturen und Magnetfelder, Mikrowellenstrahlung, Staub) hohe Gasströme gefördert werden. Die gepumpten Gase bestehen überwiegend aus Deuterium, Helium und Tritium sowie Verunreinigungen.

Das Vorhandensein von Tritium - ein radioaktives Gas, das mit dem Luftsauerstoff zündfähige Mischungen bildet - stellt besondere Anforderungen an die Sicherheit und die Materialverträglichkeit der verwendeten Komponenten. Fette und Öle als Schmier- und Dichtstoffe sind in den Vakuumpumpen ebenso verboten wie das Verwenden von Spül- und Sperrgas oder Gleitringdichtungen.

In diesem Vortrag wird das Vakuumsystem eines Fusionsreaktors vorgestellt und auf die veränderten Anforderungen bei dem Sprung von einem experimentellen Reaktor auf einen kommerziellen Fusionsreaktor eingegangen. Technische Lösungsansätze sowie deren Entwicklungsstatus werden aufgezeigt und diskutiert.

VA 1.3 Mon 11:00 HFT-FT 131

New Bayard-Alpert Gauge for UHV and XHV Measurement down to 5E-12 mbar — •Nikolas von Freyhold, Ivan Pongrac, Jaroslaw Iwicki, Heiko Wunderlich, and Ute Bergner — VACOM Vakuum Komponenten & Messtechnik GmbH, Jena, Germany

An increasing number of UHV applications require vacuum gauges for measuring total pressures in the range of 1E-10 mbar to 1E-11 mbar (abs.) with a certain accuracy and reproducibility. For this purpose, ionization vacuum gauges of different types are the preferred sensors. They measure ion or discharge currents that are proportional to the pressure, however nonlinearities must be taken into account towards their lower measurement limits. Bayard-Alpert hot cathode ionization gauges as well as the different cold cathode gauge types are quite dissatisfactory regarding the pressure range mentioned above, since their measurement range is limited to some E-11 mbar. Besides, the calibration of frequently used "nude" Bayard-Alpert gauges is depending strongly on the distance between sensor electrodes and the surrounding wall of the vacuum chamber.

We will present a new Bayard-Alpert hot cathode gauge optimized for UHV measurements. This gauge combines a stable calibration with successfully demonstrated improvements in terms of lower pressure limit, featuring pressure readings from 1E-2 to 5E-12 mbar. Experimental results in comparison to other Bayard-Alpert gauges and an Extractor gauge will be presented and discussed.