Atmospheric pressure vacuum degassing technology

Today， the secondary metallurgical unit represents a versatile and usable link between the primary steelmaking process and the liquid steel continuous casting process. Vacuum degassing is an important secondary steelmaking process. The process was originally used to remove hydrogen from the steel， but is now also used in secondary refining and has become an increasingly important secondary steelmaking process. Lower hydrogen and nitrogen content， ultra-low carbon content， ultra-low sulfur content， low total oxygen content and cleanliness of the steel are the reasons for installing vacuum treatment facilities in steel melting plants.

In new steel plants， vacuum degassing facilities are considered and integrated into the steel production line. There is also a trend to install vacuum handling facilities in existing plants in order to provide steel mills with the opportunity to expand their product mix and respond more flexibly to the steel market situation.

Since the 1950s， several vacuum technologies have been developed for degassing purposes. These technologies include DH (Dormund Hoerder) degassing， RH (Ruhrstahl Heraeus) degassing， vacuum tank degassing (VTD)， vacuum arc degassing (VAD) and vacuum induction melting (VIM). In the present case， RH degassing and VTD processes are usually used for large-scale production of steel to reduce the gas and carbon content of the melt. the choice of RH degassing or VTD is strictly determined by the steel grade produced by the steel mill. In most cases， the RH degassing installation is more advantageous compared to VTD， especially for large heat mills because of its good mixing properties and short decarbonization and degassing cycle times， resulting in a large number of heat treatments per day. Due to the short cycle time， the RH degassing process can handle a

large amount of heating per day. In addition， due to the good mixing performance achieved in the process， short treatment times can be achieved regardless of the ladle size.

The RH degassing technology was first introduced in the late 1950s in Germany， where the first RH degassing plant was developed and installed. the RH degassing process is named after Ruhrstahl and Heraeus， where the process was originally developed. Since then， many process improvements have been made to the RH degassing equipment. These improvements include the installation of oxygen lances， the enlargement of breather tube and vessel diameters， and the application of powder injection for desulfurization. kuwabara presented a comprehensive model for decarbonization of RH degasification equipment， taking into account vacuum pressure， lift gas flow rate， vessel and breather tube diameters. The time required to reach a carbon content below 20 ppm (parts per million) in RH degassing equipment can reportedly be accomplished in less than 15 minutes.

When equipped with an additional top bar， RH degassing is referred to as RH-TOP degassing.RH degassing and RH-TOP degassing equipment (Figure 1) use the vacuum recirculation process principle and are particularly suitable for producing steel grades with very low carbon content under economically favorable conditions.The main functions of RH degassing equipment are hydrogen removal， natural and forced decarburization， chemical heating of the steel， and precise adjustment of the steel chemical analysis and temperature. These activities are carried out under vacuum conditions. Low hydrogen content is the main prerequisite for the production of high-strength steel grades and those used in the oil and gas industry. Relative humidity degassing technology allows to achieve very low hydrogen content in a very short vacuum time.

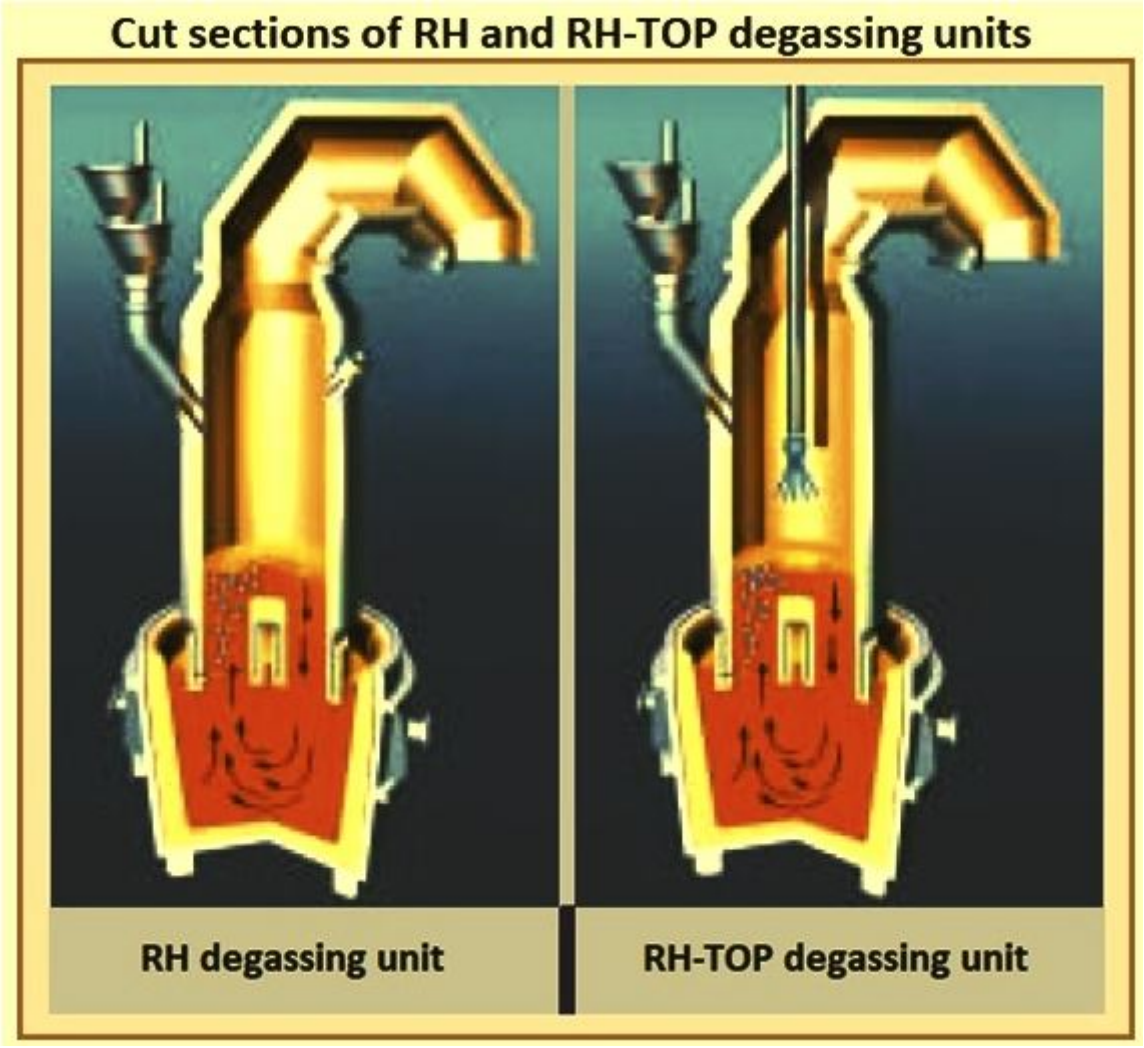

Fig. 1 Cross-sectional view of RH and RH-TOP degassing equipment

As a tool for secondary refining of liquid steel， the RH degassing process has most applications due to its multiple metallurgical functions， such as vacuum degassing， decarburization， inclusions removal， denitration and inclusions removal. It is widely used for the production of ultra low carbon steel， bearing steel， pipe line steel， spring steel and silicon steel.

RH degassing equipment usually consists of a refractory-lined block or split vessel with two refractory-lined breathing holes in the bottom of the vessel connected to a vacuum pump. Other components include a hydraulic or mechanical vessel or ladle lifting system (in the case of RH-TOP)， a multifunctional top blow gun， and a measuring and sampling system. The addition of material under vacuum is accomplished by a vacuum hopper system.