EMBR is a prerequisite when casting thin slabs with higher throughputs and when you are aiming at the higher quality segment.

- Nearly complete elimination of mold powder entrapments as the result of reduced flow speed and turbulence.
- Greatly improved coil surface quality.
- Higher casting speed can normally be used.
- Reduction of mold copper wear, especially at higher casting speeds.
- Reduced meniscus swelling resulting in a more even molten mold powder layer.
- Hotter steel at meniscus.
- New market segments will be within reach because of improved product quality.

In summary, EMBR will increase productivity, product quality and lower operating costs.
EMBR for thin slab casters

Reduced mold powder entrapments
Inclusions coming with the steel remains small and relatively harmless because of the Ca-treatment of the steel. Because of this and the high casting speed normally used for thin slabs, mold powder entrapment constitutes the major source of detrimental non-metallic inclusions.
With an EMBR, the lower meniscus flow speed and turbulence results in that mold powder entrapments will be nearly eliminated. These data were generated by an optical surface detection system located after the last stand in the hot rolling mill. They and show that more than 90% of the non-metallic inclusions are eliminated.

Improved coil quality
The higher the casting speed the lower the quality will be. This is evident from the figure, where non-metallic inclusions in coils are shown as a function of throughput and EMBR current. These results come from an optical surface detection system located after the final stand in the hot rolling mill. It can clearly be seen that when using an optimized EMBR the quality level at higher throughputs is improved. The quality becomes equal or better to the quality level to that for significantly lower casting speeds without EMBR.

Reduced meniscus waving/swelling
The braking of the steel jets exiting the SEN reduces the meniscus swelling close to the mold narrow sides. The resulting flatter meniscus allows for a more even layer of molten mold powder, thus improving lubrication and reducing the risks of surface cracks.
The meniscus profile has been measured by dipping a thin metal sheet into the mold. A typical dip sheet holder is shown at the top of the picture.
EMBR increases mold lifetime.
EMBR dramatically decreases the mold level fluctuations. Therefore temperature cycling and thermal fatigue of the copper mold plates dramatically reduced. Thanks to that more than twice as long mold lifetime has been reported from casters using EMBR.

EMBR increases steel temperature at meniscus.
Since the EMBR reduces the turbulence in the steel, heat transfer from the middle of the mold to the solidification front is reduced. Additionally, hot steel is not pushed down into the strand but kept higher up in the mold, resulting in an increase of the steel temperature at the meniscus, see figure to the right. The temperature at the meniscus was measured by dipping down a thermo-element into the steel.

New markets
Thanks to the dramatic improvements in quality, new markets with improved profitability, such as the white products sector, will be within reach of many flat product mini-mills. This has already been proven by several steelmakers with thin slab casters using EMBR.

Productivity improvements
As a consequence of the quality improvements coming from using an EMBR system, the casting speed can normally be increased resulting in increased productivity. This is especially important to steel shops with only one thin slab strand feeding a dedicated hot rolling mill.
The EMBR consists of two or four part coils, placed at each mold wide side. The part coils are fed with direct current from a thyristor converter. The generated static magnetic field brakes the flow speed of the steel jets from the SEN thereby reducing the turbulence. The higher the metal flow speed the higher the braking force. The following two EMBR configurations are available:

**EMBR Ruler.** The braking area of the Ruler covers substantially the entire width of the slab. Two part coils (shown in red in the figure) with electrical copper windings together with iron cores and outer iron yoke form a closed magnetic circuit.

**EMBR Local Fields.** Unlike the Ruler, the braking area covers the steel outlet from the SEN. Four part coils with electrical copper windings (shown in red in the figure) together with cores and outer yokes form a magnetic circuit. This type of EMBR is especially suited for rebuilding of existing casters.

The following different methods are used to install EMBR:

**Window solution for new casters.** The part coils are mounted on the non-oscillating magnetic yoke surrounding the movable iron cores. In order to minimize the non-magnetic gap, these iron cores fit in the front position in “windows” in the mold water jacket, also allowing for mold oscillation.

At mold exchange, the iron cores are retracted and the mold can then be lifted out of the caster, while the part coils remain in the caster. This installation method minimizes the weight on the oscillation table since the cores and yokes do not oscillate.

**Integrated solution for existing casters.** The part coils and the magnetic cores and yokes are mounted on the mold and go in and out of the caster with the mold during mold exchange.