New magnet for handling hot coils

Coil magnets replace tongs

For several decades there has been a continuing trend to replace mechanical grippers such as tongs by electromagnets. The benefits of electromagnets when compared with tongs include:

- Fast picking and storage of coils as well as ease of use
- Optimum stacking height of coil piles thanks to low overall height of the magnet
- High storage density due to elimination of gripper clearance between coil eyes
- Transport without damage to coil edges
- No moving parts, therefore much lower maintenance costs

Figure 1: Air gaps in windings of hot-rolled coils

400°C coils – too hot to touch!

Hot-rolled coils become less tightly wound during cooling due to contraction of the individual layers. As a result, air gaps appear between the layers (see Figure 1). The greater the air gap or sum of the air gaps in the coil, the greater the impact on the lifting power of the magnet.

Steel retains its magnetic properties up to a temperature of 768°C. Beyond this temperature, steel loses its ferromagnetic properties. For a material temperature of 400°C, the magnetic lifting force is only 75% of the force available when the material is at 0°C.

For safety reasons, this loss of lifting force has to be compensated. For flat material (e.g. hot billets or slabs), the compensation is achieved by increasing the contact area between the material and magnet(s). In the case of round material, this may be difficult or impossible since the area of contact is limited to a single line (see Figure 2).

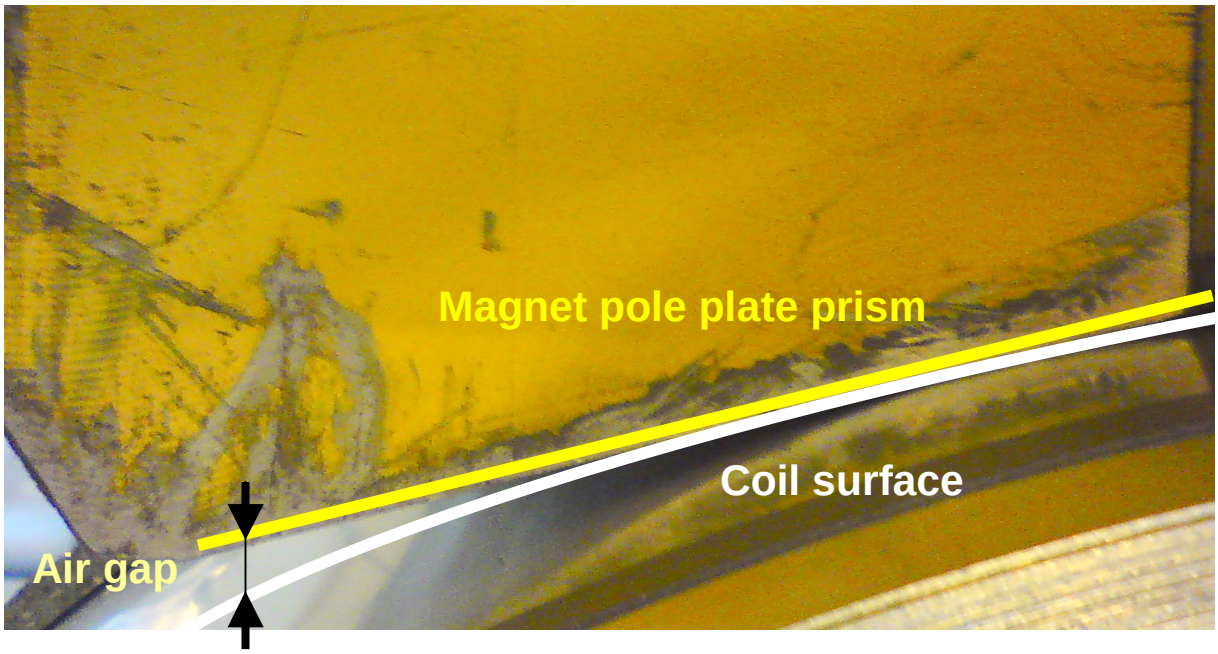

Figure 2: Magnet pole plate on round coil surface

The TRUNINGER Solution

Our vast experience as a manufacturer of magnet systems places us in an ideal position to offer solutions for such challenging applications. Thanks to a whole series of protective measures, hot coils up to 400°C can be safely transported:

Temperature-related protective measures

- Use of temperature-resistant sealing compound
- Use of heat-resistant insulating material
- Heat shields to protect the magnet coils from the radiated heat
- Thermal insulation inside the magnet protects the coils against conductive heat
- The whole magnet surface is designed as a passive cooling unit

Design features

- Optimised magnet design using FE methods
- Specially aligned magnetic field for deep penetration into hot-rolled coils
- Improved magnet pole geometry
- Temperature monitoring of the magnet coils

Tata Steel Netherlands Project

In 2011, a coil magnet for the safe transport of hot coils, was commissioned at Tata Steel in IJmuiden, Holland. The hot coils are loaded directly from the production line onto railway wagons and brought to the warehouse unloading station. There, the 400°C hot coils are picked with the magnet and placed automatically in the intermediate compact coil storage area. After cooling the coils are retrieved from storage, placed on a transfer carriage and later dispatched to the pickling line.

Automatic handling of hot-rolled coils requires sophisticated communication between inventory control systems, crane and magnet equipment.

- All crane movements are locked while the magnet is powering up
- For safety reasons, lifting is always done with reduced lifting capacity (Partial Load)
- Switch to Full Load is automatic
- Crane travel is locked until the magnet has reached maximum hoisting height
- Magnet cannot be switched off if a suspended load is detected by the load cell
- Magnet cannot be detached from the coil until the degaussing program is complete

Figure 3: Storage of a hot-rolled coil in the warehouse

Technical Data

Magnet payload	27 t
Diameter of coils	800 to 2300 mm
Maximum load temperature	400°C
Duty cycle	75% at 250°C coil temperature
	60% at 400°C coil temperature
Air gap tolerance	Σ Air gap = 19mm
Special feature	redundant magnet system

The coil magnet is equipped with two independent coil packs. The coil packs are controlled and monitored separately. In the event of failure of one coil pack, the load is supported by the remaining coil pack. The failure is reported by a visual and acoustic alarm and also by a signal to the controlling crane via a communication interface. The transport process is then terminated, the load is set down and the magnet is switched off.

Figure 4: Coil being prepared for placement on the transfer carriage