Refractory Engineering
Furnace Optimization by Mettop
# TABLE OF CONTENT

1 EXECUTIVE SUMMARY ................................................................................................................................. 3
2 METTOP AT A GLANCE ................................................................................................................................. 4
3 3D REFRACTORY ENGINEERING .................................................................................................................. 5
4 ADD-ONS – SPECIAL SERVICE BY METTOP .............................................................................................. 7
   4.1 QUALITY CONCEPT ............................................................................................................................... 7
   4.2 LINING SEQUENCE ............................................................................................................................... 7
   4.3 HEAT TRANSFER CALCULATION AND EXPANSION CALCULATION .............................................. 8
   4.4 START-UP PROCEDURES AND HEATING UP INSTRUCTION ............................................................. 9
   4.5 SPECIAL SUPPORT AND TRAINING COURSES ............................................................................... 9
5 HOLISTIC APPROACH – SCOPE OF SERVICE BY METTOP ....................................................................... 10
6 CONTACT ....................................................................................................................................................... 11
1 EXECUTIVE SUMMARY

It is the rising demand for economic and cost saving operation mode within all metallurgical plants that makes every aggregate unique and makes tailor made solutions absolutely essential for an optimized process. Especially regarding refractory lifetime and furnace availability subsequently, a rethinking of the prevailing refractory concept can lead to significant improvements.

Upgrading of the existing furnace refractory design can lead to a wide range of improvements:

- Optimized visualization of the refractory material by exclusively 3D engineering
- Combined consideration of furnace geometry, steel construction, refractory material and arrangement
- Prolong refractory lifetime by contribution to optimized operation (heating up specifications and expansion calculation)
- Speed up installation by providing lining sequences
- Best furnace availability because of support before, during and after installation on site
- Comparing different suppliers’ grades for guaranteeing the best available product
- Cost saving lining concept by choosing price optimized material
- Best available concept by implementation of modern operational systems (purging system, cooling solutions and tuyere arrangements)

With these tools it is possible to achieve the following aims:

- Increasing furnace campaigns
- Increasing furnace availability
- Decrease costs for refractory material
2 METTOP AT A GLANCE

Mettop GmbH is an independent Austrian engineering company, which was founded in 2005. Mettop is specialized in process design, process optimization, and process engineering with the focus on:

- Feasibility studies on metallurgical processes
- Basic and detail engineering of metallurgical processes
- Technical process optimization
- New tankhouse technology, the METTOP-BRX Technology
- New cooling technology, the Ionic Liquid Cooling Technology (ILTEC)
- Cooler design, integrated solution for cooler, refractory and process conditions
- Delivery of coolers
- Refractory engineering
- Delivery of refractory
- Staff-training for realization of the provided technical innovations
- Trading technical devices and equipment in the frame of the above described company subjects
- According to the specific customer and project, the above-mentioned products and services are provided as either complete package or single parts

Mettop’s activities include the field of the pyro- and hydrometallurgy of non-ferrous metals as well as the iron and steel industry. The scope of service comprise optimization work in the area of furnace construction (furnace integrity), like refractory linings, gas purging systems, and cooling systems. In the field of hydrometallurgy, a new electrolysis technology - the Mettop-BRX Technology - was developed, which is already used commercially. For all metallurgical aggregates and equipment, Mettop developed a new cooling technology ILTEC, which uses an ionic liquids as cooling medium instead of water.
3 3D REFRACTORY ENGINEERING

In contrast to the state of the art refractory engineering in two dimensions, Mettop uses 3D refractory engineering to optimize refractory linings and furnace concepts. 3D refractory engineering requires a full design of all lining details during the construction and drawing stage. This is a big advantage compared to 2D refractory engineering, as cutting bricks on site can be avoided with the detailed 3D design. Consequently, time and also costs during installation can be saved. Furthermore, the 3D refractory engineering allows a step-by-step visualization of the installation procedure. This again facilitates the refractory installation.

3D engineering of the furnace allows the automatic generation of a complete parts list of all bricks and additional parts (e.g., steel plates, hanging hooks, expansion inserts), as all parts are named systematically and are saved in a comprehensive list. Each brick format and every additional part is only drawn once and then copied, so that the parts list can be generated automatically and contains all the information required for the refractory lining installation, for example required amounts of brick formats and qualities, number of expansion inserts, weight, volume and positioning of bricks in different furnace areas.

In Figure 1 the difference between 2D and 3D can be seen.

Figure 1 – Comparison of a 2D refractory drawing of an off-gas opening of a drum type anode furnace and the same part drawn in 3D. The sophisticated steps, ledges and brick formats can hardly be distinguished in 2D whereas in 3D each brick is visualized.
Figure 2 – Various examples of 3D engineering
4 ADD-ONS – SPECIAL SERVICE BY METTOP

With the finalization of the drawings for the refractory engineering, the service of Mettop is not finished. For the purpose of providing the best possible concept for a best possible operation of the entire process, refractory engineering comprises of more than drawings.

4.1 Quality Concept

As an independent refractory supplier without any production site or contract to refractory producers, Mettop can select the best available material for providing an independent and process orientated optimized concept. Since the scope of supply can only consist of refractory engineering, a material list totally neutral and without any relation to manufacturer can be offered. This allows the customer to independently order the refractory material according to the provided quality concept. In addition Mettop provides full service in terms of ordering, shipping and delivery including supervision on site if requested.

Based on the metallurgical and process knowhow the decision about the best available refractory material has to be considered individually for every customer and application. This means also that for one single furnace different brick qualities and subsequently different suppliers are used, just as desired by the customer.

4.2 Lining Sequence

In order to make the installation and the lining work on site as easy as possible, a visualization of the lining sequence can help immensely. With the 3D engineering tool, a brick by brick visualization of the entire lining can be provided, for example as a video or as single pictures. This helps to prevent cost, time and material consuming failures during the lining and will lead to a more economical and cost saving lining.
4.3 Heat transfer calculation and expansion calculation

For providing not only the best material but the best lining result, an optimized furnace performance is also significantly influenced by the startup procedure. Since expansion during heating up is a topic of significance, a careful consideration of the behavior during heating up is inevitable.

In Figure 5 an example for both, the steady state heat transfer calculation and the expansion calculation is given. As a result of the heat transfer calculation the expansion of the different materials at the different installation positions are known and instructions can be given how to prevent damage of the refractory during the start up.
4.4 Start-up procedures and heating up instruction

Once the furnace is lined, the operation mode starts with a first heating up of the furnace. Especially too rapid heating can cause irreversible cracking but furthermore, too little heat at some areas of the furnace might result in condensation and subsequently cracking because of hydration.

In order to prevent any damage caused by inappropriate heating, a specific and detailed description of the heating up procedure is proposed.

![Specific heating up description](image)

**Figure 6 – Specific heating up description**

4.5 Special Support and Training Courses

It is of superior interest to provide the best possible performance on applying a new refractory concept, however not only in terms of material performance. Therefore we take service seriously and assist in all sorts of issues.

- Installation on site:
The entire installation on site will be supervised by Mettop personal.

- After Sales service:
In case either any unlikely event or planned maintenance, Mettop provides after sales service and special support.

- Training courses
For optimized profiting from the benefits and using the entire metallurgical potential of refractory engineering it is of interest to fully understand the metallurgical background of the processes. Therefore Mettop provides detailed and comprehensive training courses on site for teaching the operators metallurgical knowhow combined with operational instructions.
5 HOLISTIC APPROACH – SCOPE OF SERVICE BY METTOP

The scope of service of Mettop is intended as being a holistic concept for creating an optimized process. The offered refractory engineering itself comprises of the following:

- 3D Engineering
- Construction plans
- Complete list of parts
- Independent and process orientated optimized concept
- Technical documentation

Since Mettop combines substantiated knowledge about refractories with profound metallurgical know-how, it is intended to be part of the entire process concept. On letting Mettop be part of the process, the following tools are used for optimizing processes:

- Thermodynamical modelling with HSC
- CFD modelling
- Optimized construction
- Optimized refractory design for less wear
- Most modern cooling systems
- Possibility of improvement of metallurgical processes via purging systems

Finally, after having created a refractory concept, Mettop will support the customer in every possible way for achieving an optimized performance:

- Visualization of the lining sequence, step by step installation procedure
- Heating up description
- Considerations regarding possible problems on site (hydration,...)
- Extension calculations and instructions
- On-site support, supervision during start up
- After sales service and special support
- Training courses for operators
6 CONTACT

Mettop GmbH
Peter-Tunner-Strasse 4
8700 Leoben
Austria
www.mettop.com

Dr. Iris Filzwieser:  +43 664 88 60 45 41  iris.filzwieser@mettop.com
Dr. Andreas Filzwieser:  +43 664 88 60 45 40  andreas.filzwieser@mettop.com
DI Stefan Wallner  +43 664 88 60 45 53  stefan.wallner@mettop.com