Lungmuß
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Lungmuß
Tap Hole Clays

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1. Development of Lungmuß' tap hole clays

On the field of tap hole clays, the Lungmuss Company has been among the leading producers worldwide for more than 35 years. In relation to environmental protection, we were among the first to develop tar-free and pitch-free tap hole clays, which are eco-friendly. The main advantage of these resin-bonded clays are the significantly shortened derivation action times. Therefore they can also be used for soaking bar technique.

The enlargement of the blast furnaces and the increase of the furnace efficiency demand a continuous development and adaptation of the tap hole clays.

Lungmuss tap hole clays are successfully used in blast furnaces from six meters up to 15,1 meters of hearth diameter and with one to four tap holes. Depending on the quality of the resin and the temperature in the tap hole channel, the tap hole gun remains in place for 2-12 minutes. Tap to tap time in one tap hole operation ranges from 10 to 60 minutes.

Different furnace sizes and varying ways of running the blast furnace require tailor-made tap hole clays. The clay has to be adjusted to the special parameters and working conditions at every single blast furnace. The plasticity of the clay can be modified according to the strength of the machine and the outside temperatures.

In addition to our tap hole clay we offer special repairing mixes. These mixes a very soft, almost liquid, and have a high resin content. They are used for filling cracks in the carbon blocks or sealing other leakages around the tap hole area. These repairing mixes can either be produced as a very soft clay to be used with the tap hole gun or as a liquid material to be used with a pump.

A smooth blast furnace operation strongly depends on the quality of the tap hole clay. The tap hole clay should meet the following demands:

- **Adjusted plasticity** – smoothness in tap hole gun and tap hole channel ⇒ accurate filling of tap hole channel

- **Quick and reliable hardening/binding of the clay**
  ⇒ safe closing of the furnace

- **High pig iron and slag resistance** at ceramic, mechanical and chemical attack ⇒ constant diameter of tap hole channel during the entire tapping

... and supply the following needs:

- **Easy drilling**
  ⇒ in case of weak drilling machine

- **Fast binding at low temperatures**
  ⇒ in case of well-cooled tap hole faces

- **Slow binding**
  ⇒ in case tap hole gun is not cooled or placed closely to the runner

2. Consistence of Lungmuß' tap hole clays

Lungmuß tap hole clays have changed remarkably within the past 35 years. The mixtures are more complex nowadays so that up to 18 different components are used in one clay.
The tap hole clay consists of the following components:

Raw Material Basis: It forms the refractory basis of the clay and has to guarantee the stability in the upper temperature range (> 1.400°C).
Raw materials on Al_2O_3 and SiO_2 basis have proved their suitability.
Used are: Clay sticky sand, fire clay, bauxite, corundum, andalusite, mullite, tabular alumina

Bonding Agents: The bonding system serves mainly to the quick hardening of the clay in the tap hole channel. It has, additionally, to guarantee the resistance of the clay against pig iron and slag in the temperature range up to 800°C. We use different types of phenolic resin that harden at temperatures from 100°C to 200°C. Furthermore, we use mineral oil or anthracitic oil as additional bearer of carbon. Both do not content benzo-apyren.

Additives: Additives have various tasks. They serve i.e. as sinter supporting agents, which stabilise the mixture in the temperature range from 800°C to 1400°C. Other tasks of the additives are the improvement of the slag stability and the improvement of the carbon frame.
Used are: SiC, Si-metal, graphite, soot, Si_3N_4

3. Lungmuß' tap hole clays: exemplifications

Tap hole clay **HT 20/1**

Customer:	Dillinger Hütte, Dillingen, Germany Blast Furnace No 4
Hearth Diameter:	10,0 m – 2 tap holes
Production:	6.000 – 6.500 t/day
Tap to tap time:	40 min.
Quantity of slag:	230 kg/t of hot metal
Method of opening:	drilling

Tap hole clay **HT 18/2 R**

Customer:	Moravia Steel, Trinec, Czech Republic Blast Furnace No 6
Hearth Diameter:	8,25 m – 2 tap holes
Production:	3.000 – 3.500 t/day
Tap to tap time:	50 min.
Quantity of slag:	350 – 450 kg/t of hot metal
Method of opening:	soaking bar / drilling

Tap hole clay **HT 70**

Customer:	Sidmar, Gent, Belgium Blast Furnace B
Hearth Diameter:	11,0 m – 2 tap holes
Production:	5.800 – 6.200 t/day
Tap to tap time:	20 min.
Quantity of slag:	200 – 220 kg/t of hot metal
Method of opening:	drilling

Tap hole clay **DS 1**

Customer:	Hüttenwerke Krupp-Mannesmann (HKM), Duisburg, Germany Blast Furnace B
Hearth Diameter:	11,0 m – 2 tap holes
Production:	7.500 – 8.000 t/day
Tap to tap time:	30 min.
Quantity of slag:	250 kg/t of hot metal
Method of opening:	drilling

4. Data sheets for the exemplifications

Product information: Blast Furnace Tap Hole Clay

HT 20/1

Date: 29.07.2004

VDEh-Code	89 39 46 05 22 60
Product type	tar free tap hole clay
State at delivery	ready for use, plastic wrapped block
Nature of bond	organic - chemical
Storage life	6 months, max. 25°C
Main raw materials	silicon carbide, bauxite, carbon

Chemical analysis	SiC	**13,4**	%
	Al_2O_3	**55,2**	%
	SiO_2	**8,9**	%
	Fe_2O_3	**1,3**	%
	C	**17,9**	%

Bulk density	2,25	g/cm³
Volatile matter content	10,6	%
Loss on ignition	11,9	%
Maximun grain size	3	mm

Workability according to EN 1402-3	20 - 30	%

Cold crushing strength	400°C / 30 min	**> 2,5**	N / mm²

Applications	For medium and large blast furnaces with high top pressure. Workability index can be varied corresponding to the strength of the tap hole guns.

Product information: Blast Furnace Tap Hole Clay

HT 18/2

Date: 23.09.2007

VDEh-Code	89 39 46 05 22 60
Product type	tar free tap hole clay
State at delivery	ready for use, plastic wrapped block
Nature of bond	organic - chemical
Storage life	6 months, max. 25°C
Main raw materials	silicon carbide, bauxite, carbon

Chemical analysis	SiC	**13,0**	%
	Al_2O_3	**48,0**	%
	SiO_2	**19,0**	%
	Fe_2O_3	**-**	%
	C	**11,0**	%

Bulk density	2,2	g/cm³
Volatile matter content	10,0	%
Loss on ignition	12,5	%
Maximun grain size	3	mm

Workability according to EN 1402-3	18 - 30	%

Cold crushing strength	400°C / 30 min	**> 2,5**	N / mm²

Applications	For medium and large blast furnaces with high top pressure. Workability index can be varied corresponding to the strength of the tap hole guns.

Product information: Blast Furnace Tap Hole Clay

HT 70

Date: 22.09.2006

VDEh-Code	89 39 46 15 23 60
Product type	tar free tap hole clay
State at delivery	ready for use, plastic wrapped block
Nature of bond	organic - chemical
Storage life	6 months, max. 25°C
Main raw materials	silicon carbide, corundum, carbon

Chemical analysis	SiC	**17,3**	%
	Al_2O_3	**43,0**	%
	SiO_2	**16,4**	%
	Fe_2O_3	**1,8**	%
	TiO_2	**1,5**	%
	C	**17,7**	%

Bulk density	2,30	g/cm³
Volatile matter content	11,0	%
Loss on ignition	12,5	%
Maximun grain size	3	mm

Workability according to EN 1402-3	18 - 28	%

Cold crushing strength	400°C / 30 min	**> 15,0**	N / mm²

Applications	For medium and large blast furnaces with high top pressure. Workability index can be varied corresponding to the strength of the tap hole guns.

Product information: Blast Furnace Tap Hole Clay

DS 1

Date: 20.11.2006

VDEh-Code	89 39 46 15 23 60
Product type	tar free tap hole clay
Delivery condition	ready for use, plastic wrapped block
Nature of bond	organic-chemical
Storage life	6 months, max. 25°C
Main raw materials	silicon carbide, corundum, carbon

Chemical analysis	SiC	**16,8**	%
	Al_2O_3	**43,6**	%
	SiO_2	**11,5**	%
	Fe_2O_3	**0,5**	%
	TiO_2	**1,5**	%
	C	**18,7**	%

Bulk density	2,30	g/cm³
Content of volatile Components	11,0	content in weight %
Ignition loss	12,5	content in weight %
Max. grain size	3	mm

Workability according to EN 1402-3	18 – 28 %

Cold crushing strength	400°C / 30 min	**> 15,0**	N / mm²

Applications	For medium and large blast furnaces with high top pressure. Plasticity can be varied corresponding to the strength of the tap hole guns.

5. Reference list for resin-bonded tap hole clays

COMPANY NAME	BLAST FURNACE	HEARTH DIAMETER	PRODUCTION OF HOT METAL IN 24 H	METHOD OF OPENING
HKM, Duisburg, Germany	A	10,3 m	7.000 t	Drilling
HKM, Duisburg, Germany	B	11,0 m	7.500 t	Drilling
Salzgitter AG Salzgitter, Germany	A	11,0 m	6.000 t	Soaking Bar
Salzgitter AG Salzgitter, Germany	B	11,2 m	5.500 t	Drilling
Salzgitter AG Salzgitter, Germany	C	8,2 m	2.000 t	Drilling
ArcelorMittal Bremen, Germany	2	12,0 m	7.000 t	Soaking Bar/ Drilling
ArcelorMittal Bremen, Germany	3	9,0 m	3.500 t	Drilling
Dillinger Hütte Dillingen, Germany	4	10,0 m	6.500 t	Drilling
Dillinger Hütte Dillingen, Germany	5	12,0 m	7.500 t	Drilling
Voest-Alpine Stahl Linz, Austria	A	12,0 m	9.500 t	Drilling
ArcelorMittal (Sidmar) Gent, Belgium	A	11,1 m	6.200 t	Drilling
ArcelorMittal (Sidmar) Gent, Belgium	B	10,5 m	6.000 t	Drilling

5. Reference list for resin-bonded tap hole clays (2)

COMPANY NAME	BLAST FURNACE	HEARTH DIAMETER	PRODUCTION OF HOT METAL IN 24 H	METHOD OF OPENING
Rautaruukki Raahe, Finnland	2	8,5 m	3.700 t	Drilling
ArcelorMittal Krakow, Poland	3	8,0 m	3.000 t	Drilling
ArcelorMittal Krakow, Poland	5	9,7 m	4.000 t	Drilling
ArcelorMittal Katowice, Poland	2	12,0 m	7.000 t	Drilling
ArcelorMittal Katowice, Poland	3	12,0 m	6.000 t	Drilling
Severstal Cherepovets, Russia	5	15,1 m	11.500 t	Drilling
Severstal Cherepovets, Russia	4	11,5 m	6.500 t	Drilling
NTMK Nishny Tagil, Russia	6	9,7 m	4.000 t	Drilling
Moravia Steel Trinec, Czech Republic	4	8,25 m	3.400 t	Soaking Bar
Moravia Steel Trinec, Czech Republic	6	8,25 m	3.400 t	Drilling
ArcelorMittal Ostrava, Czech Republic	2	8,5 m	2.500 t	Drilling
ArcelorMittal Ostrava, Czech Republic	3	8,5 m	3.200 t	Soaking Bar
ArcelorMittal Ostrava, Czech Republic	4	8,5 m	3.200 t	Soaking Bar

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