RAMM Metals, Inc.

www.rammglobal.com

SUCCESSFUL BUYER / SUPPLIER PARTNERSHIP TO ACHIEVE LONG MOLD LIFE

FROM SUPPLIER:

- ⇨ **FULL CAPABILITY AND ON TIME DELIVERY**
- ⇨ **QUALITY ASSURANCE (ISO 9000)**
- ⇨ **TECHNOLOGICAL CAPABILITY TO MAKE THE APPROPRIATE GRADE OF CAST IRON FOR EACH SPECIFIC APPLICATION**
- ⇨ **TECHNICAL SUPPORT TO THE CUSTOMER , SUCH AS :**
  - **REDESIGN OF MOLDS**
  - **DESIGN OF NEW SIZES**
  - **ADVICE ABOUT REPAIR METHODS**
  - **ADVICE ABOUT USAGE CONDITIONS**
  - **PROMPT SERVICE WHEN REQUIRED**

FROM BUYER:

- ⇨ **FEEDBACK OF USEFUL LIFE AND SCRAP REASON**
- ⇨ **PREVENTIVE REPAIRING PROGRAM (if it's economical)**
- ⇨ **CONTROL OF USAGE CONDITIONS**
- ⇨ **GUARANTEE OF A MINIMUM VOLUME OF RELEASES**

FROM BOTH:

- ⇨ **CONTINUOUS IMPROVEMENT PROGRAM AIMING A HIGHER USEFUL LIFE AND A CONSEQUENT LOWER FINAL COST**
- ⇨ **PRICE NEGOTIATION BASED ON THE FINAL COST OF THE MOLDS**

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USAGE IN THE STEEL PLANT

As it is very known, the conditions of use of a mold in a steel plant is responsible for, at least, 50% of its useful life.
Some of the factors, such as type of steel, temperature and method of ingot casting can not be modified only with the objective of bettering the performance of the mold. However, other factors can be improved by the steel producers without affecting the quality of the steel products, such as:

- Control of the temperature of the mold before steel casting. The recommended range is 80 to 120 C. In frigid winters cold molds must be pre-heated.

- Mold cooling method, looking for lowering of its wall's temperatures as isothermically as possible and preferably slowly by natural air.

- Mold temperature cycle . A period of time after stripping until the next steel casting should be specified aiming to keep the mold temperature in the recommended range. So, an adequate number of molds is necessary to maintain the rotation of the molds.

- Molds positioning lay out with an enough space among them to facilitate the heat dissipation from their walls. It's a factor to be considered previously during the steel casting project.

- Removal of ingot as gently as possible (without hitting, banging). This is possible when a proper equipment is used (for example : hydraulic stripper), and/or when a good internal surface of the mold is kept with a preventive conditioning program, such as grinding of its internal walls after a certain number of runs.

An internal surface conditioning program is the most important repair because it is **preventive**. The periodic removal of the oxidized superficial layer together with the first row of superficial cracks can provide good economic gains due to the increased life of the mold and the decrease in surface defects on the ingot and subsequent products.

Some kinds of **corrective** repair are available. Modern welding processes to repair internal erosions and also resistant steel staples/bands to repair external cracks are commonly well acceptable repair services offered by specialized companies.
Economic decision to repair a mold ➔ A simple formula can be used:

$$R = \frac{W \times N \times C}{L}$$

W : **W**eight of the mold (Ton)
N : **N**umber of pours after repair (statistical prediction)
C : Net **C**ost of the mold ($ / Ton) => price of a new mold minus its value as scrap
L : **L**ife (number of pours) before repair
R : Cost **R**eduction
If **R** is higher than the cost to make the repair, then, the best decision is in repairing the mold.

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FINAL COST OF INGOT MOLDS

The final cost of ingot molds can be calculated as below :

$$FC = \frac{Ic + Uc - Sr}{Ni} \quad \text{or} \quad FC' = \frac{Ic + Uc - Sr}{Ti}$$

Ic : Initial Cost or purchase price
Uc : In Usage Cost (preventive conditioning/repair costs + inspection/control costs + handling costs + inventory costs)
Sr : Scrap Recovery or selling price of discarded mold as iron scrap
Ni : Number of Ingots or pours produced by the mold (useful life)
Ti : Tonnage of ingot produced by the mold

FC : Final Cost in $/ingot or $/pour

FC' : Final Cost in $/Ton of Ingot

COMMENTS :

- The In Usage costs can be reduced significantly when the molds are produced with a consistent and high quality level, as described below:

APPROPRIATE IRON GRADE ➔ NO EARLY CRACKS/EROSIONS ➔ LOWER REPAIR COSTS

HIGH DIMENSIONAL ACCURACY ➔ NO EARLY CRACKS ➔ LOWER REPAIR COSTS

ASSURED QUALITY (ISO 9000) ➔ LOWER INSPECTION/CONTROL COSTS BY CUSTOMER

HIGHER AND CONSISTENT USEFUL LIFE ➔ LOWER INVENTORY COSTS

- The useful life is the most influent part for the final cost of the molds , since it can be improved in a wider range than the other parts of the final cost ;

- The optimization of the useful life of the molds is achievable with a strong partnership and commitment between founder & user, because it depends on difficult changes and developments in both sides.
(manufacturing variables - design - chemistry & microstructure - usage & repair)

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DESIGN OF THE MOLD

ELEMENTS OF THE MOLD DESIGN:

- Dimensions of the cross section
- Height
- Internal Taper

} mostly determined by the ingot design

⇨ - **Thickness of the walls: Calculated by specific formulas (RAMM knows how)**

- Reinforcement bands
- Lugs / trunnions / staples / pads / slots
- Weight of the mold and ingot (M / I ratio)
- Corner radius
- Curvature of the inside and outside surfaces
- Cast marks (logo , size code , serial # , etc)
- Other elements

OUTSIDE MOLD WALL {

TOO THIN => { EARLY CRACKS ON THE MOLD / LATE SOLIDIFICATION OF THE INGOT

TOO THICK => { HIGH M / I RATIO / QUICK SOLIDIFICATION OF THE INGOT

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MANUFACTURING VARIABLES

What	Why	How
FLATNESS AND SMOOTHNESS OF THE INTERNAL AND TOP AND BOTTOM SURFACES	GOOD INGOT SURFACE AND NO LEAKS OF STEEL BETWEEN MOLD - HOT TOP AND MOLD - STOOL	**-STANDARDIZED FINAL INSPECTION** **-SMOOTH FINISHING & MACHINING** **-SAND MOLD WITH HIGH STRENGTH** **(no bake process)** **(vibrating table for high compacting)** **-MOLD PAINT WELL DRIED** **-MOLD PAINT WITH HIGH REFRACTORINESS** **(graphite – zirconia)**
DIMENSIONAL ACCURACY (precision & exactness)	MINIMUM VARIATION OF THE INGOT CAVITY VOLUME (steel yield) AND MAXIMUM BALANCE OF THE MOLD WALL THICKNESS (no early cracks) AND CORRECT LOCATION OF LUGS/TRUNNIONS/ STAPLES & PADS (no accident in handling)	**-STANDARDIZED FINAL INSPECTION** **-STATISTICAL CONTROL & TRACEABILITY SYSTEM** **-RIGID PATTERN AND CORE-BOX** **(periodic inspection)** **-STANDARDIZED ASSEMBLY OF CHEEK FLASKS AND CORES WITH DOWEL PINS** **-SAND MOLD WITH HIGH STRENGTH**
SOUNDNESS	NO PREMATURE DAMAGES (cracks & erosion)	**-MACHINING OF THE TOP AS CAST** **(kish removal)** **-APPROPRIATE CAST TEMPERATURE** **(statistical control & traceability system)** **-APPROPRIATE GATING & RISERING & POURING FLOW** **-SAND MOLD WITH HIGH STRENGTH AND WELL DRIED AND CLEANED**