

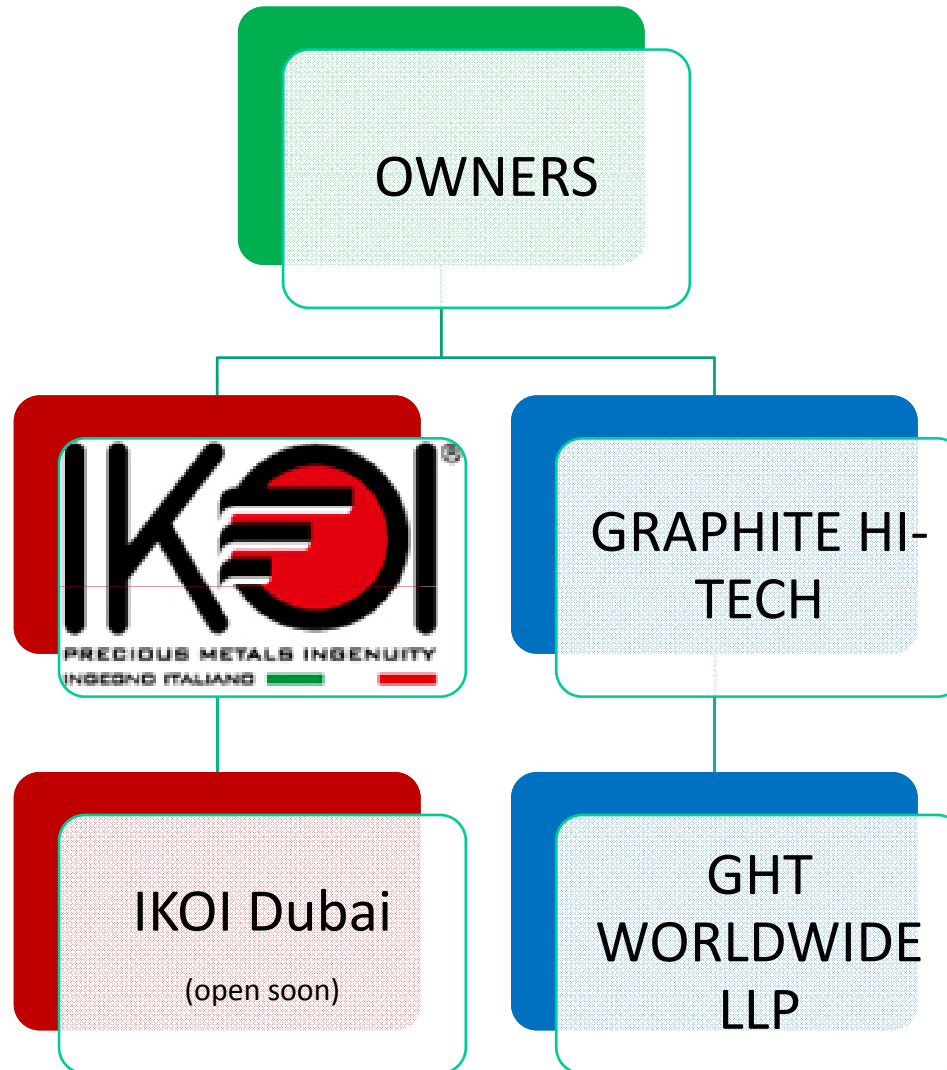


Induction System:

The NEW NORMAL for producing Casted Investment Bars after the last Process Technology Improvements

*Alessandro Borghi,
Area Manager
IKOI Unipersonale Srl*

INTRODUCTION OF OUR GROUP



INTRODUCTION OF OUR COMPANY



FLAMELESS TUNNEL[®]



MACHINERY AND PLANTS FOR THE PRODUCTION OF
GOOD DELIVERY BARS 400oz Gold and 1000oz Silver



Production Capacity:

- from 2 up to 12 of **400 Oz Au G.D. Bars** per hour
(from 16 up to 100 pcs/shift)
- from 2 up to 12 of **1.000 Oz Ag G.D. Bars** per hour
(from 16 up to 100 pcs/shift)

Loss of weight : 0,1 g per Good Delivery bar *



GOOD DELIVERY BARS  **FLAMELESS TUNNEL® OUTPUT**



400 Oz Gold



1000 Oz Silver



1000 Oz Silver



400 Oz Gold

MACHINERY AND PLANTS FOR THE PRODUCTION OF
CASTED BARS 50g to 5Kg

FLAMELESS TUNNEL® TECHNOLOGY*

* Patented Technology



Production capacity :

- from 12 up to 200 **kilo-bar** or **500 g** ingots/h
- from 24 up to 400 of **250 g** ingots/h
- from 48 up to 800 of **100 g** or **50 g** ingots/h

Machines treat Gold and Silver independently



Loss of weight : 0,01 g/Kg *

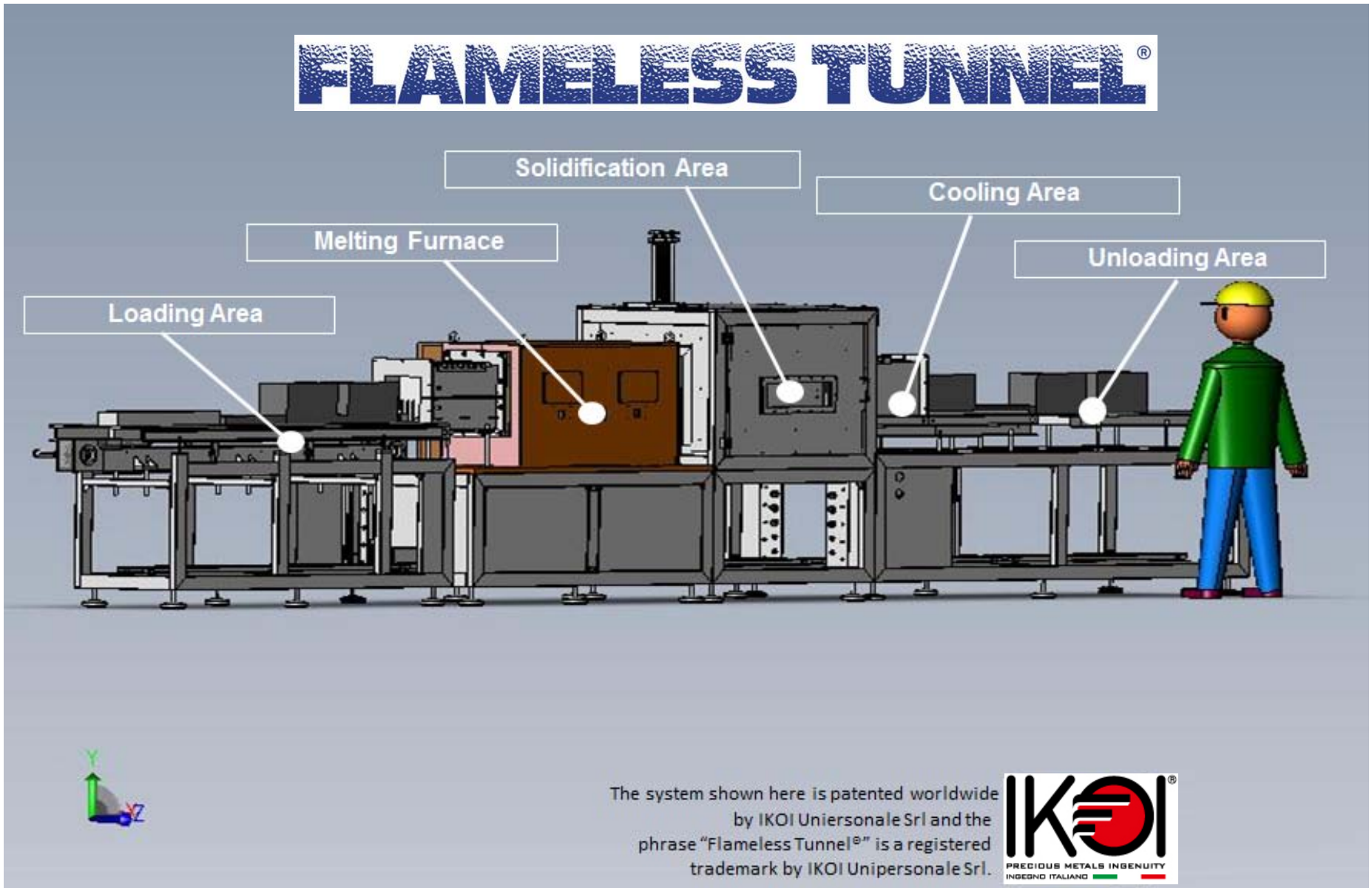
EXAMPLE OF KILO-BAR FLAMELESS TUNNEL®



EXAMPLE OF SHANGHAI GOLD EXCHANGE 3 KILO-BAR



DESCRIPTION OF THE FLAMELESS TUNNEL® FURNACE





ADVANTAGES OF THE FLAMELESS TUNNEL[®] PROCESS

- ✓ Significant reduction of rejects due to increased quality of the bars

TRADITIONAL SYSTEM



1000 oz Ag bar - central shrinkage hollow



400 oz Au bar



400 oz Au bar - dendrites, oxide formations and porosity



1000 oz Ag bar - uncontrolled shrinkage

ADVANTAGES OF THE **FLAMELESS TUNNEL**® PROCESS

- ✓ Significant reduction of rejects due to increased quality of the bars

FLAMELESS TUNNEL® SYSTEM



ADVANTAGES OF THE **FLAMELESS TUNNEL®** PROCESS

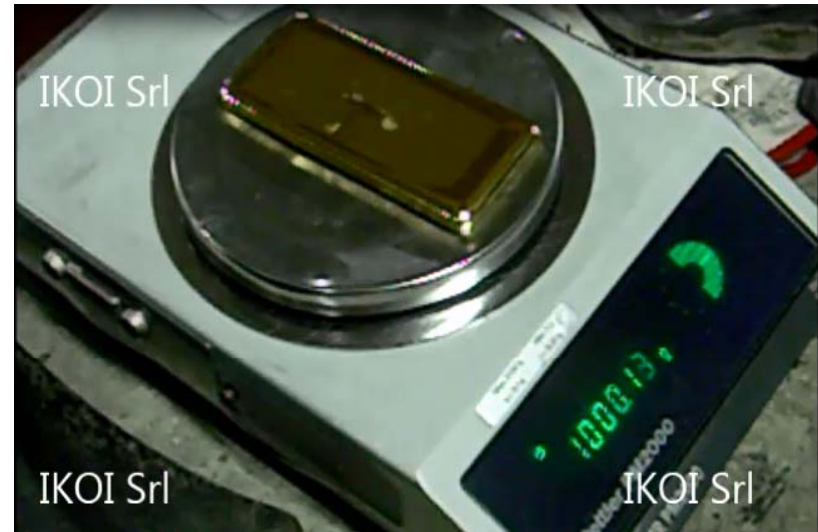


Cancellation of precious metal losses

- TRADITIONAL SYSTEM : ~0,1 g lost
- **FLAMELESS TUNNEL®** : 0,01 g lost



Weight of the granules BEFORE producing a gold Kilobar with an FLAMELESS TUNNEL® furnace



Weight of the Kilobar AFTER being produced with the granules of the left picture into an FLAMELESS TUNNEL® furnace (it means: no weight loss)

ADVANTAGES OF THE **FLAMELESS TUNNEL**® PROCESS

- ✓ **Better for the Environment (“green technology”)**



ADVANTAGES OF THE **FLAMELESS TUNNEL**® PROCESS

✓ **Safer for the operators**



ADVANTAGES OF THE **FLAMELESS TUNNEL** PROCESS

✓ **Significant Reduction of electricity consumption**

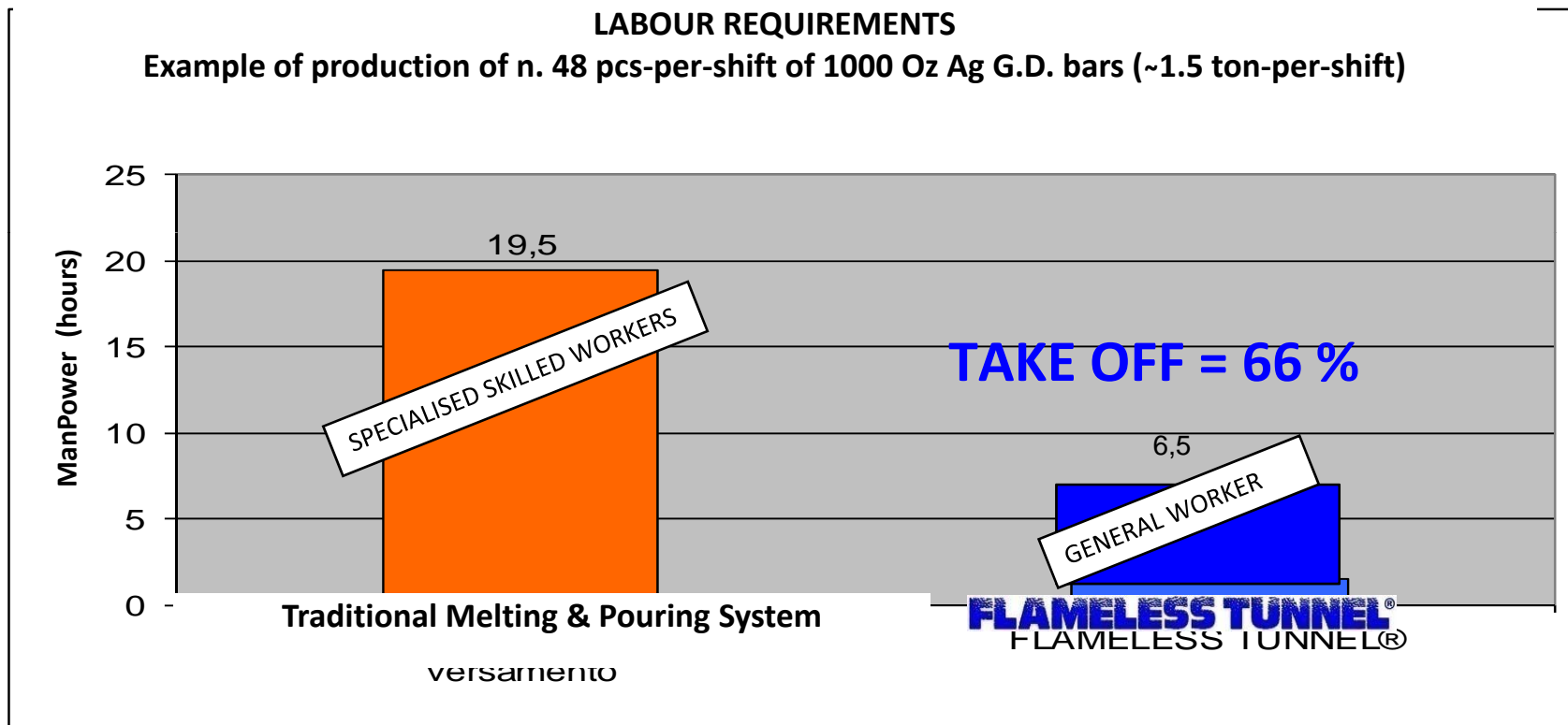
- TRADITIONAL SYSTEM : about 2500 KWh
- **FLAMELESS TUNNEL** : about 2000 KWh

✓ **Cancellation in radiant and convective heat loss**



ADVANTAGES OF THE **FLAMELESS TUNNEL®** PROCESS

✓ **Significant Reduction of the labour time** for the production

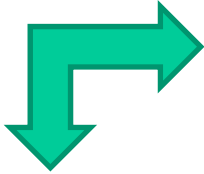


✓ **Faster production times**

- TRADITIONAL SYSTEM : 12 hours
- **FLAMELESS TUNNEL®** : 8 hours
- **TAKE OFF : 33,3 %**
- INCREASING OF THE MATERIAL TURNOVER

Production of 32 bars of 1.000 Oz Ag (1 ton) *

ADVANTAGES OF THE **FLAMELESS TUNNEL** PROCESS



**NOT SPECIALIZED SKILLED
WORKERS REQUESTED FOR THE
PRODUCTION**

**TRADITIONAL MELTING &
POURING SYSTEM**

 **FLAMELESS TUNNEL**



SPECIALISED SKILLED WORKERS



GENERAL WORKER

ADVANTAGES OF THE **FLAMELESS TUNNEL**® PROCESS

- ✓ **Increased quality of the bars**
- ✓ **Cancellation of the precious metal loss**
- ✓ **Better for the Environment (“green technology”)**
- ✓ **Safer for the operators**
- ✓ **Reduction of electricity consumption**
- ✓ **Cancellation in radiant and convective heat loss**
- ✓ **Reduction of the labour time**
- ✓ **Faster production times**
- ✓ **Not specialized skilled workers requested**



LBMA Good Delivery Rules Modifications

15th April:

In the 2013 new edition of the LBMA Good Delivery Rules the

Until the 2012 edition, the words "graphite moulds" and "induction tunnel furnace" were never been mentioned...

...starting from the 2013 edition, the words "graphite moulds" and "induction tunnel conveyor system" are now mentioned and accepted by LBMA!

Of course the words "graphite moulds" and "induction tunnel conveyor system" are referring at the Flameless Tunnel made by IKOI!

FURNACE INNOVATIONS :



... (see Annex G "Weighing, Packing and Delivery Procedures for Gold and Silver Bars")

Casting Method: Bars must be produced in graphite or cast iron moulds, either by the conventional method of pouring molten metal into them or alternatively, by melting grain in an induction tunnel system. Silver bars may also be produced using continuous casting. Existing GDB refiners wishing to convert to the use of the above-mentioned non-conventional methods of production must submit a proposal to the LBMA for consideration prior to implementation.

2014 !

LBMA ACCREDITATION FOR BOTH GOLD AND SILVER BARS!

Now both Gold and Silver bars can be produced: "in graphite moulds" and "by melting grain in an induction tunnel conveyor system". Obviously these words refer to IKOI Flameless Tunnel® System

LBMA Good Delivery Rules September, 2014

dimensions, the LBMA will allow it a grace period of 6 months to change the dimensions so that existing moulds can be used while new moulds are obtained.

7.2 Quality Control
If bars are delivered into the London market and the recipient vault is of the opinion that the bars do not conform to the above requirements, the recipient vault may ask the LBMA to appoint independent inspectors to examine the bars and express an opinion as to whether the bars are acceptable for Good Delivery purposes. For the avoidance of doubt, any proposed recipient of bars has, irrespective of any view expressed by an inspector on the condition of a bar, the absolute right to refuse to accept delivery of a bar if its vault manager considers that the bar does not meet the Good Delivery standards as set out in these Rules.

7.3 Non-Good Delivery Bars
If bars are produced in the general form of Good Delivery bars, but due to their intended use (for example bars produced for use and delivered directly to an industrial customer, for use as a raw material) they do not meet the Good Delivery specifications (for example, inferior appearance or sub-standard bar marks) then the Good Delivery refiner must stamp the bars NGD (meaning Non-Good Delivery) in close proximity to the LBMA-approved manufacturer's mark.

7.4 General Description of Good Delivery Bars
Weighting: Bars should be stamped with the weight as shown laid down by the LBMA in Annex G "Weighing, Packing and Delivery Procedures for Gold and Silver Bars".

Casting Method: Bars must be produced in graphite or cast iron moulds, either by the conventional method of pouring molten metal into them or alternatively, by melting grain in an induction tunnel system. Silver bars may also be produced using continuous casting. Existing GDB refiners wishing to convert to the use of the above-mentioned non-conventional methods of bar production must submit a proposal to the LBMA for consideration prior to implementation. The LBMA may also require the refiner to submit a proposal to the LBMA for consideration prior to implementation. The Refiner must pay for the LBMA's costs in the examination and testing of the bars.

Shape: Bars must be ingot-shaped (i.e., having a trapezoidal cross section, both along the length and across the width of the bars) with sufficient undercut to facilitate handling but without resulting in the width of the bottom surface being so narrow that the bar cannot be safely stacked. Bars cast in open moulds should be produced at a single pouring. Bars must be easy and safe to handle. Refiners must also ensure that their bars will stack safely when considering the dimensions of their proposed GDB bar. Proper stacking and handling of a bar will be taken into consideration during bar inspections. It is important that the edges of the bars must not be sharp, so as to avoid the risk of injury during handling.

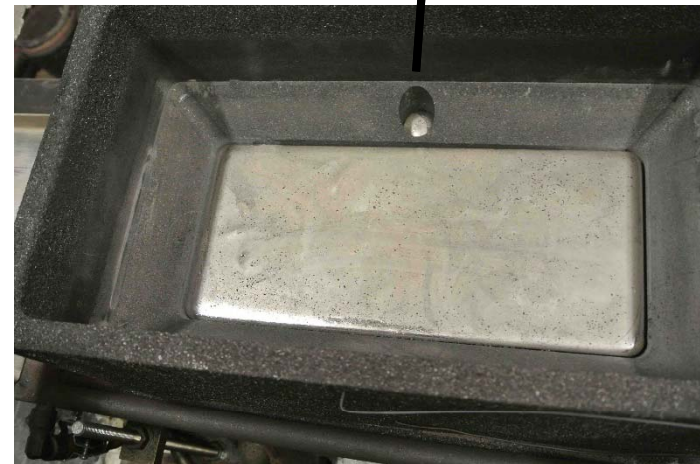
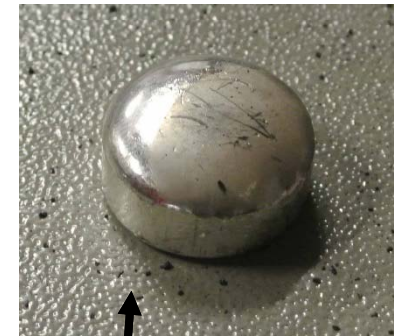
Undercut: The undercut refers to the degree of slope on the side and ends of the bar and is represented by the angle of deviation from the vertical of the side and end surfaces. The previous method of calculating undercut involved deducting the dimension of the bottom edge of the bar from the dimension of the top edge and dividing the result by the top edge dimension multiplied by one hundred to obtain the percentage undercut. This method is no longer used.

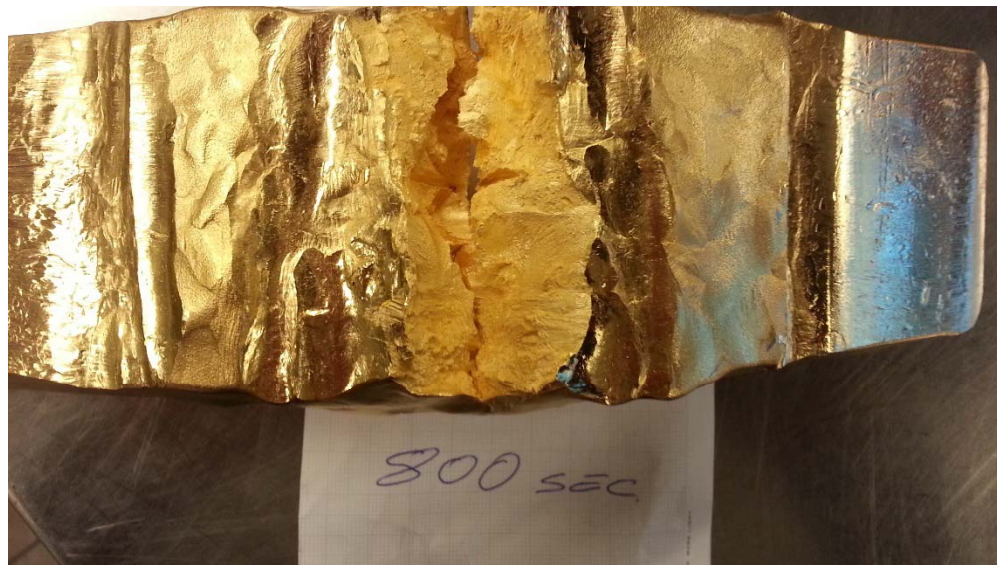
Appearance: Bars must be of good appearance. Factors that must be avoided, especially on the top surface of a bar, are irregularities such as top face oxidation, cracks, holes or fillet-like inclusions and water can accumulate in such irregularities which can affect the weight of the bar and, accelerated water can cause an explosion when the bars are melted and excessive shrinkage (i.e. the tendency, at the top face of the bar and any concave coating rings must not be such that it makes it difficult to bar apply or read the bar marks or in the case of rectangular bars become unstable when stacked on top of each other). The sides and bottom (smaller) surface should be reasonably smooth (which does not imply the need for a mirror-like finish) and free from oxides, lumps and excessive burring. Lapping is considered to be excessive if it can result in dust or dirt being trapped and thus affecting the recorded weight of a bar. In the case of bar production



DIP Sampling Procedures available

WORLDWIDE IKOI PATENT







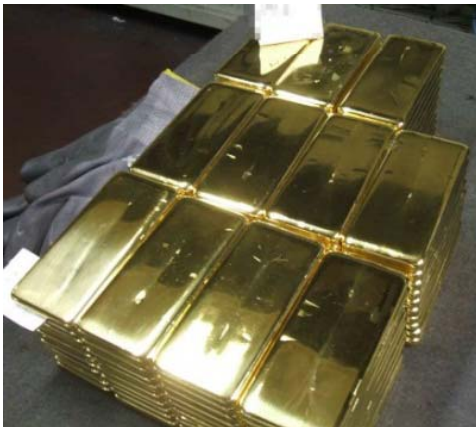
FSS System - Flat & Shine Surface System

WORLDWIDE IKOI PATENT

WITHOUT FSS

Example of ingots produced by IKOI
"Standard" technology

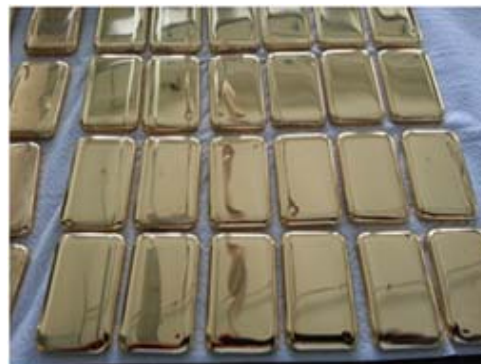
With which you get ingots widely
acceptable quality and fully complies
with international standards



WITH FSS

Example of ingots produced by IKOI
"FSS" technology

Flat & Shine Surface, with which you
obtain ingots with higher quality, with
flat and shine surface



OLD TUNNEL FURNACE TECHNOLOGY YEARS 90 :



1:

Melting temperature

2:

Melting timing

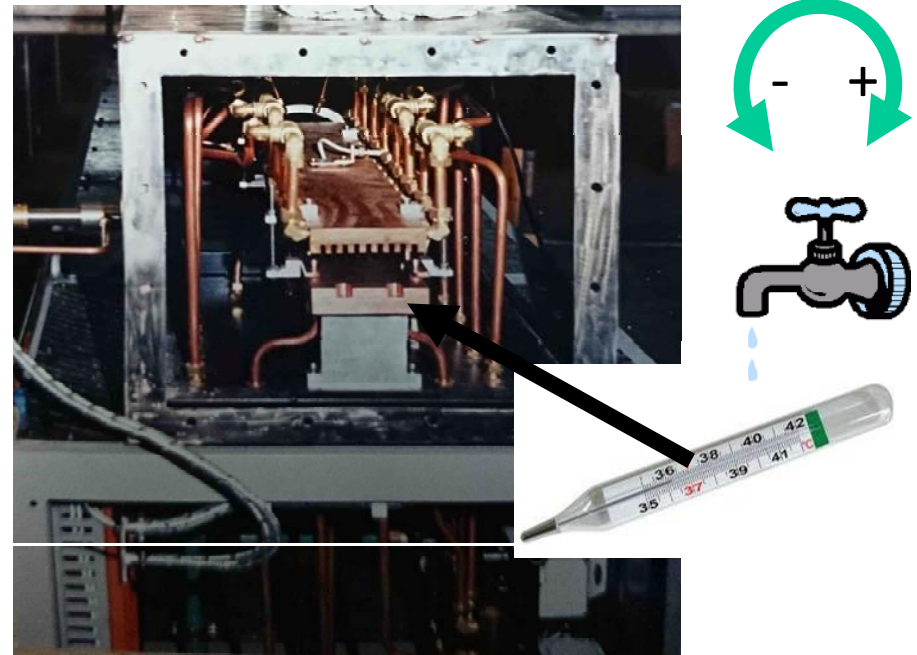
**(it is also the solidification timing,
because the tunnel is “by step”)**



OLD TUNNEL FURNACE TECHNOLOGY YEARS 90 :

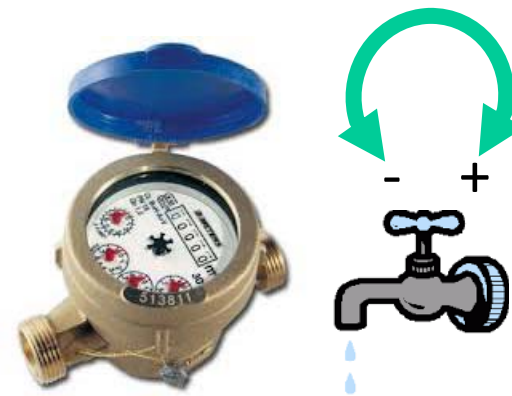
3:

Cooling water temperature
that flowing in the
solidification plate



4:

The flow rate (capacity) of the cooling
water flowing in the solidification plate



OLD TUNNEL FURNACE TECHNOLOGY YEARS 90 :



Technicians start setting up the mentioned 4 parameters....

First ... temperature...

Then ... the timing....

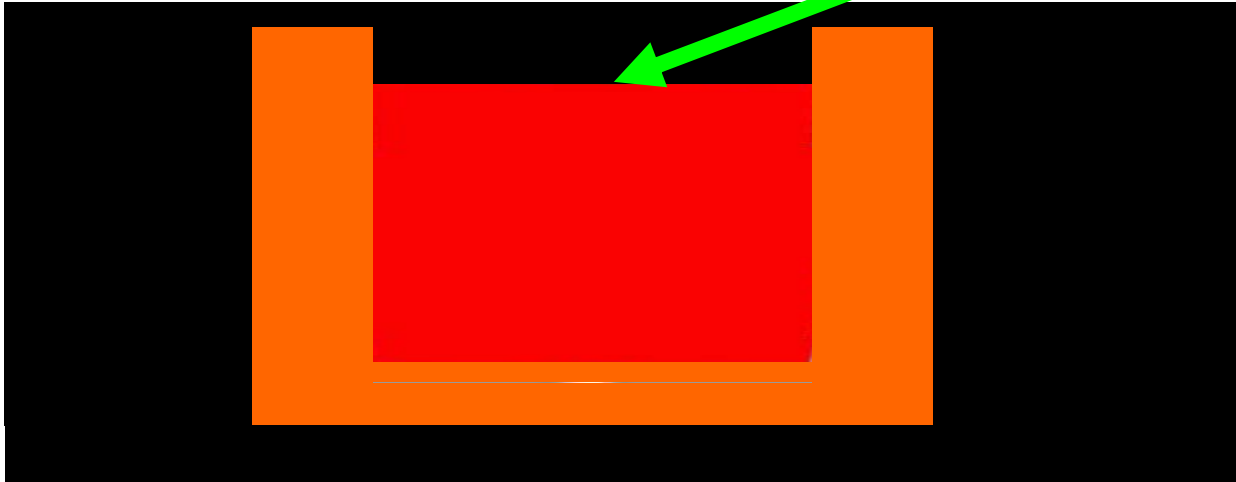
Then the water flow rate...

Then again the temperature, again the flow rate, then water temperature, and so on for hours of tests...

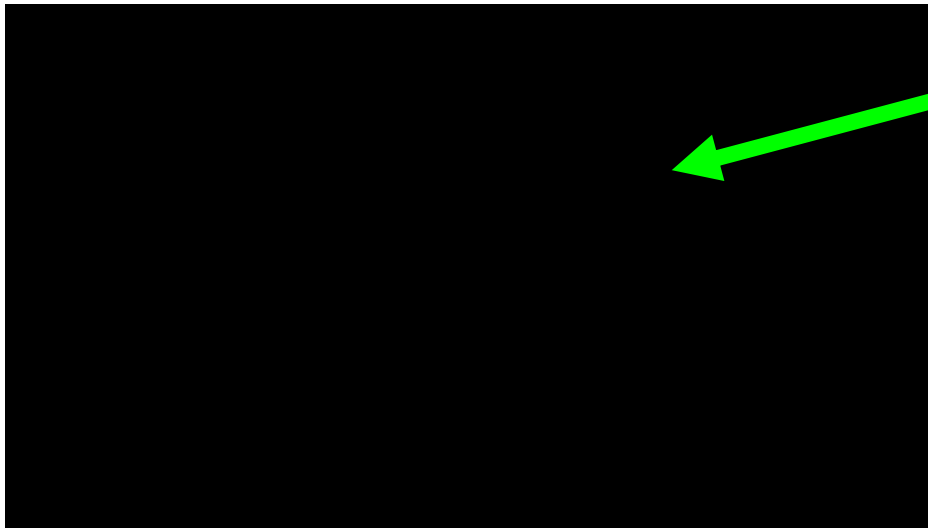
...at the end, near evening, we are able to produce some acceptable quality ingots, even if with some defects

OLD FURNACE TECHNOLOGY:

The solidification is concentrate in one point.
On the surface there are retreats, waves and stains



SOLIDIFICATION ON **IKOI** WITH TECHNOLOGY 90'S



The solidification is uniformly distributed





FLAMELESS TUNNEL® FURNACE OPEX ASSUMPTION:

ANNUAL PRODUCTION of 16.000 G.D. Bars of 1.000 Oz
250 Working days/year
8 Working hours/day
1 Working Shift a day

Man Power cost: 19.88 US\$/hour
Cost of Electricity: 0.165 US\$/hour

TRADITIONAL SYSTEM

2 PEOPLE
1.5 WORK SHIFT
**PRODUCTION OF 5.33 G.D.
BARS/HOUR**

FLAMELESS TUNNEL FURNACE

1 PERSON
1 WORK SHIFT
**PRODUCTION OF 8 G.D.
BARS/HOUR**



MAN POWER

TRADITIONAL SYSTEM

2 PEOPLE
US \$ 79,400.00

**FLAMELESS TUNNEL
FURNACE**

1 PERSON
US \$ 39,700.00

**ENERGY
CONSUMPTION**

TRADITIONAL SYSTEM

2,500 kW
US \$ 103,500.00

**FLAMELESS TUNNEL
FURNACE**

2,000 kW
US \$ 82,800.00



FLAMELESS TUNNEL® FURNACE ANNUAL OPEX:

PROPANE & CARBON CONSUMPTION AND MAINTENANCE COST

TRADITIONAL SYSTEM

US \$26,500.00 (48 Kg/8 hours, 2.2 US\$/Kg)

US \$ 2,485.00

US \$ 38,657.00

FLAMELESS TUNNEL FURNACE

US \$ 0

US \$ 0

US \$ 27,600.00

COST OF PM RECOVERY

TRADITIONAL SYSTEM

US \$ 31,420.00

FLAMELESS TUNNEL FURNACE

US \$ 10.000



FLAMELESS TUNNEL® FURNACE ANNUAL OPEX:



FLAMELESS TUNNEL®

ANNUAL SAVING

US \$ 131,060.00

26.97 US \$/each

TRADITIONAL SYSTEM

**- 12.5
US \$**

14.47 US \$/each

FLAMELESS TUNNEL

THANK YOU!



MADE IN ITALY

[http: www.ikoi.it](http://www.ikoi.it)

.....THE STORY CONTINUES, YOU ARE PART OF IT !!!

*All mentioned data and pictures in the present ppt presentation are not binding and are only used, as example, for commercial purpose