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MINI SMELTING PLANT FOR PROCESSING GOLD-BEARING CONCENTRATES, MELTING AND REFINING METAL

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ABSTRACT
In Copper Institute Bor, a new type of metallurgical converter is developed for melting gold-bearing concentrates and refinery of metals. Institute has, within its priorities for more dynamic appearance on domestic and foreign markets, included also program for adopting and improving the technology for pyrometallurgical processing of gold-bearing complex raw materials. Experimental works on semi-industrial plant for processing of these materials are in completing stage. Melting unit is cylindrical converter which blows and mixes liquid with tilting motions, 45 degree, left and right. The Unit is supply with liquid fuel burner and atomizers for additional blowing of fuel and providing reductive atmosphere, which is necessary for some phases in the process. After commissioning and setting mini production line, with verified technology, in perspective there is production of larger capacity unit for melting according to this technology. Two experimental tests of melting, oxidation and reduction of melt is given in this paper.

Keywords: Mini smelting Plant, Gold-bearing concentrates, Cylindrical tilting converter

1. SELECTION AND QUALITY OF RAW MATERIALS

Pyrometallurgical methods are suitable for processing of both sulfide and oxide raw minerals, which consists of Pb, Zn and Cu as well as precious metals. It is preferable to make these raw materials enriched firstly (gravitational separation, flotation) to collective concentrate with content of gold 50-120 g/t. In that way, economy and efficiency of pyrometallurgical process is obtained.

2. MELTING FURNACE TILCON

Melting furnace is short-cylindrical converter with cones both ended. On the head, furnace is heated with D-2 fuel burner, and on the other end there is combustion gasses outlet. It is also 5 nozzles on cylindrical wall side that inject air into the melt. Thus melt is mixed. Additional mixing is performed with furnace tilting in the both direction, and the effect which four flippers make into the melt. Therefore, high intensification of the charge melting process is achieved. Furnace has a system for gas balance, heating and supply. Beside primary pipeline for gas supply over hot tower, there is secondary pipeline which make finally gas and heat balance in the furnace. In such way, gas sequence is balanced and its flow speed is decreased inside the furnace, which has positive effect on flame focusing and temperature release in the central part of melting furnace, where it is most required.

Nozzle construction is adapted in that way to enable placing of additional atomizers for liquid fuel dispersing into reaction space. It is used in a process phase when melt reduction i.e. finish metal refinery is required. Melting furnace characteristics are given in Table 1.

Table 1. Melting furnace characteristics

Characteristics	Unit	Value
Furnace total volume	l	240
Melt volume	l	80
Fuel consumption (D-2)	l/h	8-12
Nozzle	Nr(ID,mm)	5(10)
Gas temperature	^{o}C	1250

3. PROCESS TECHNOLOGY

Raw materials (concentrates) for melting are firstly palletizing with fluxes and help of bonding agent. The formed pellets are charged into furnace and heated up to charge melting temperature. In the case of sulfide concentrates melting, sulfide melt is blown to total elimination of sulfur from charge. During this operation, also easy-evaporated zinc oxide (ZnO) is removed. After discharging operations, melt is further put through reduction to remove oxygen. Usually final melt consist of copper and lead, which collect precious metals. That metal-collector and precious metal alloy is called ″Dore″ as final product of pyrometallurgical process. Technological sheet for pyrometallurgical processing of sulphide/oxide concentrates is given in Figure 1. Spatial display of melting furnace with devices for gas treatment is given in Figure 2.

4. TRANSPORT, PURIFICATION AND PROCESSING OF GASES

The gases from combustion of fuel and combustible element in charge are transported from the furnace through two separate braches: primary through heating tower, secondary, though burner head. Technology for furnace lighting determined with balanced gas flow for uniform temperature flux on all unit volume. It is achieved by adjusting slides on primary and secondary part of the pipeline. The dust particles are separated in cyclone. Gas temperature should be lowered, after its entry in the bag filter, is achieved with specific mixing of gas and ambient air. After dry filtering gas, gas is transported into tower for wet treatment in the scrubber. Liquid is atomized in upper part and gas in supplied in the down part of the tower. Beside gas washing, which removes also small dust particles, reactions should provide present SO_2 gas. For this purpose, base solutions of potassium and sodium salts are planed. Obtained sulphates would be settled in special tanks and eventually removed. Purified gas is emitted into atmosphere through fan and tin stack.

5. FURNACE OPERATION CONTROL

Technological conception of the process determines that melting furnace can rotate in defined limits of 45 degrees, in the both direction, as well as possible for final discharging of the whole melt into receiving pot. Torque is secured with motor-reducer placed on furnace stand. Furnace is leaned with special rings, which roll and lean to four bearing wheels installed on the stand. Activation and operation of motor has two positions: manual/automatic. Automatic control is represent continuous and programmed positioning of the furnace in the both direction, in time determined by technological procedure. Special attention is paid towards protection measures for starter motor, reducer and the other parts of movable mechanism, which ensure furnace operation in excess situations. Also coercive measures are determined for electric supply-voltage turn- off by pressing button on control panel and switches for operation ending which are installed on the melting furnace. Special photo cells and timers regulate final furnace position in tilting operation and time base for delay length while furnace rotation changes its course. It is possible monitored process by computer. Thus, process could be analyzed and monitored in the real time in all its phases, which would eliminate mistakes during the process.

Control point for furnace operation managing, monitoring and control of the technological parameters is placed on the location which enables possibility for complete insight into instrumental and visual control and monitoring of all technological process phases.

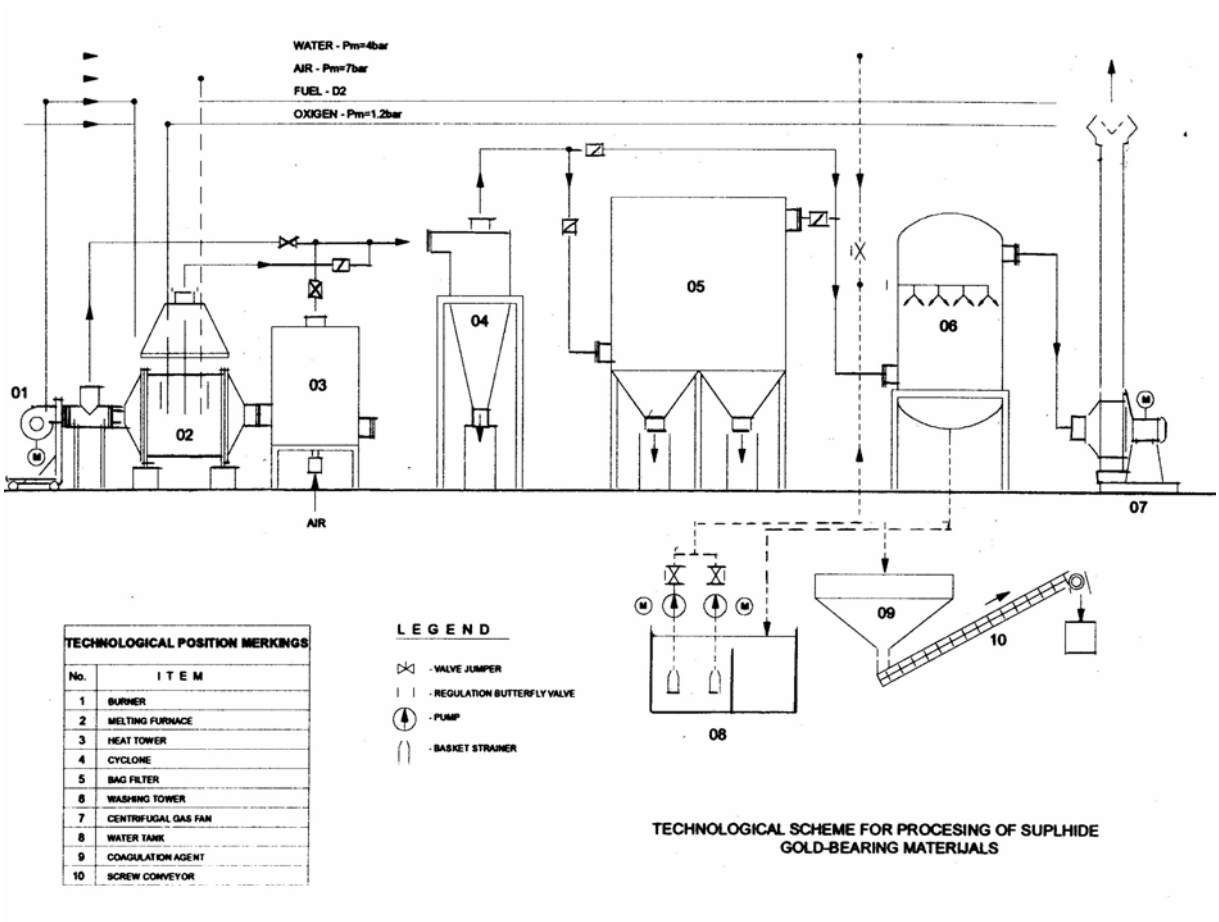

Figure 1. Technological scheme for processing of sulphide gold-bearing materials

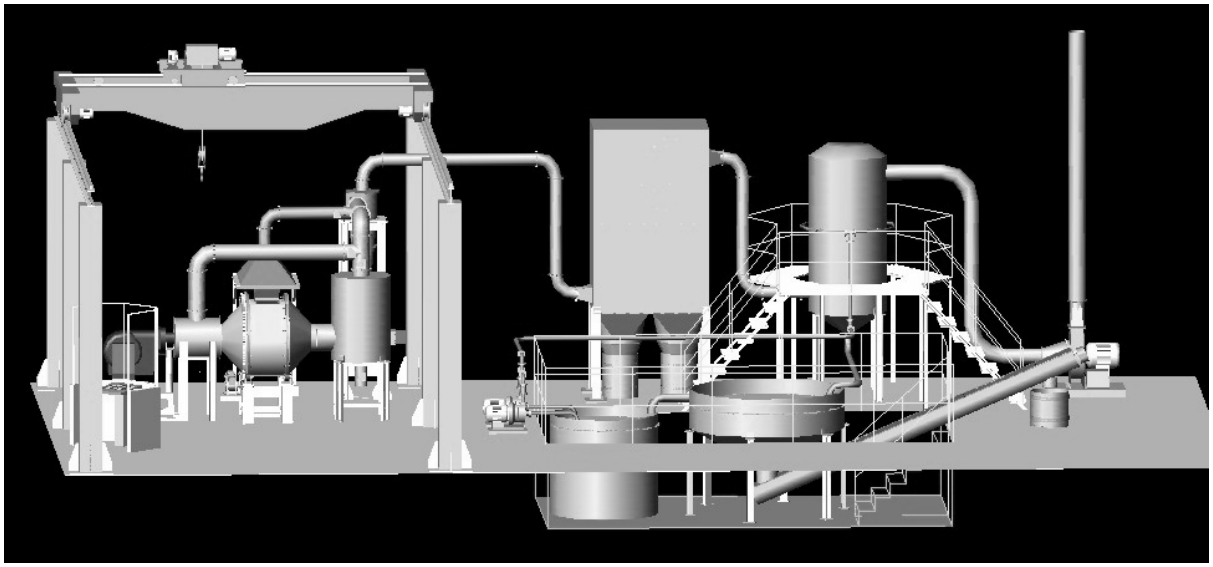

Figure 2. Spatial display of melting furnace with devices for gas treatment

6. CONCLUSION

Laboratory experiments have fully confirmed the thermodynamic calculations and assumptions and serve as basic information for a practical work and processing polymetallic sulfide concentrates. In Serbia, higher precious metal price and interest rates as a great reason that these types of concentrate will be very actual in the next time. In this way, tilting rotary converter TILCON gives very good results [1,2] in semi-industrial scale work.

7. REFERENCES

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