

Development of Advanced Cast Iron Deep Desulfurizing Units

V.I. Bolshakov¹, Yu.I. Cherevik¹, A. M. Bashmakov²

¹*Z. I. Nekrasov Iron & Steel Institute of National Academy of Sciences of Ukraine
1 Academician Starodubov Square, Dnipropetrovsk 49050, Ukraine*

²*State Research and Design Titanium Institute
180 Lenin Avenue, Zaporizhzhya 69057, Ukraine*

Developed cast iron deep desulfurizing units ensure the forced dipping of tuyere into ladle with melt, fix the tuyere in position during blowing and also increase blowing time by one tuyere up to 20 minutes and longer.

Keywords: DESULFURIZATION OF CAST IRON, FORCED DIPPING OF TUYERE AND ITS FIXATION IN POSITION

Introduction

Generalization of experience accumulated during more than twenty-year-operation of cast iron desulfurizing units of the first generation at the leading integrated iron & steel works of Ukraine and Russia [1-3] allowed creation of advanced cast iron deep desulfurizing units. During creation of this equipment there was an attempt to remove revealed disadvantages. Moreover, obtained positive experience, that shows that it is necessary to provide forced dipping of tuyere into ladle with melt at a given depth and fix stably this distance between the lower section of tuyere alloying basket or its nozzle and ladle bottom irrespective of tuyere weight, was used. Meeting this requirement ensures stable cast iron production with defined sulfur content at the minimum charge of chemical agent. Several types of drive, namely rack-and-gear drive, closed cable drive and closed double-chain drive were developed and tested under production conditions to solve this problem. We will consider each of them in detail.

Results and Discussion

An advantage of rack-and-gear drive consists in the fact that it makes it possible to install and locate tuyere in any position, also eliminates low-frequency oscillations of tuyere in a vertical plane during sulfur removal.

The disadvantage is a gear rack more than 4 m

long which is installed on a rod and makes an open gear drive operating at elevated temperatures under active abrasive wear conditions. The presence of such long gear drive complicates the drive construction, its manufacture, installation and service. When this drive is working, there are spaces in the vertical plane (rack – gear wheel) and horizontal (supporting cluster gear – guiding). They are actively progressing under abrasive wear and promote heavy dynamic loads in details and drive nodes, since stability of this drive sharply increases, and, as a result, its natural frequency rises as well as compared to the drive equipped with wire ropes. These disadvantages lead to substitution of rack-and-gear drive by cable one.

Rack-and-gear drive was substituted by closed inverse cable drive that ensured forced dipping of tuyere into the ladle during modernization of cast iron desulfurizing unit at JSC “Iron & Steel Integrated Works “Krivorizhstal” [4, 5].

Comparing this drive with rack-and-gear one, it is necessary to note that both these drives can move tuyeres of minimum weight, ensure their forced dipping and stop in the specified operating position, also save this position when blowing. An advantage of this drive is that it has softer dynamic characteristics (low free frequencies and small rigidity of drive elements), it is easier in relation to construction, service, manufacture and maintenance.

One of the most essential drawbacks of this drive is that its guides, support rolls, lower blocks and lower branch of wire rope are in the area of

high temperatures. It has a negative effect on their durability and reliability of both drive and unit as a whole. Continuous service of these units (about 30 years) led to their depreciation and obsolescence. And it was necessary to substitute them with advanced and high-duty ones.

In 2000, crucially new quantitative and qualitative result was obtained after working out and practical use of light-duty tuyeres with lining made from refractory concrete reinforced by metal fiber.

Practical use of these tuyeres as an operating tool of new generation with improved technical parameters allowed improving technical-and-economic indexes of sulfur removal process with reduced repair expenses and service charge of cast iron out-of-furnace treatment units.

Application of special mechanisms which fix tuyeres in position during sulfur removal and loosen them after blowing became an important step of advancement and equipment reliability growth. Use of these fixing mechanisms has radically changed dynamics of the drive and unit as a whole since it completely eliminated transmission of forced oscillations induced by technological load action on the unit metalwork and tuyere drive [6].

Therefore, experts of Z.I. Nekrasov Iron & Steel Institute and State Research and Design Titanium Institute advanced the technology and created new equipment ensuring cast iron production with sulfur content up to 0.005 % and less [7]. Chinese experts examined these developments and have been cooperating with our specialists since 2000.

Heat-resistant light-duty tuyeres, tuyere and tuyere drive lock mechanisms with closed double-chain drive are used in current units.

Conclusions

Since 2000 till 2007, cast iron desulfurizing units created on the basis of using results of presented investigations and developments successfully operate in 56 new plants at 34 steel works of China with total power almost 50 million tons of desulfurized cast iron per year. These cast iron desulfurizing units consist of light-duty tuyeres with increased thermal stability, tuyere and tuyere drive lock mechanisms with closed power circuit which provide forced dipping of tuyere into melt. At present, we keep on cooperating with China [4, 7].

Results of investigations and operating experience are indicative of high performance of sulfur removal technique by granulated magnesium

and reliability of current equipment developed by Ukrainian scientists for its implementation.

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Создание современного оборудования установок глубокой десульфурации чугуна

Большаков В. И., Черевик Ю. И., Башмаков А.М.

Создано современное оборудование установок глубокой десульфурации чугуна, обеспечивающее принудительное погружение фурменного устройства в ковш с расплавом, фиксирующее фурму в рабочем положении во время продувки, а также увеличивающее продолжительность продувки одной фурмой до 20-ти мин и более.