A practical treatise on the smelting and smithing of bloomery iron

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ABSTRACT: For several years, we have explored many aspects of the process of bloomery smelting in a shaft furnace. In contrast to most attempted reconstructions of bloomery smelting, our work has focused on the process itself, rather than its archaeological signatures. This paper describes a typical smelt of the most efficient regimen we have yet discovered. We will pay particular attention to methods that differ from those of most experimenters, especially with regard to blowing rate, slag management, and the recycling of furnace products. A bloomsmithing experiment is also described, and yields, resources, and labour requirements are quantified. We then offer a few observations where our experience differs from what we have read in the literature. Finally, we suggest that these methods, when applied to archaeological reconstructions of ancient bloomeries, may provide some missing answers for the archaeometallurgical community.

Introduction

We have been experimenting with the bloomery process since January 1998. From the beginning, our primary goal has been to smelt iron of sufficient quantity and quality for the creation of hand-forged artworks, and to explore the process for a deeper understanding of iron as an artistic medium. We strive to remain open to what the iron itself has to teach us, and to keep scientific presumptions in the background. Our interest and expertise is in iron and ironworking, not in archaeology or metallurgy. We feel that this devotion to the process and its product, rather than to furnace morphology or slag residue, has led us to uncover an approach to bloomery smelting which has the potential to provide more accurate data for historical and archaeological research than the current predominant models.

Our first eleven trials provided us with valuable experience, but produced only the most pitiable examples of blooms. These early blooms, besides being fist-sized at best, all had elevated carbon contents that made most of them unforgeable. We attempted to deal with these problems both by reducing the fuel:ore ratio and lowering the airflow and temperature, with disappointing results. These early attempts were also hampered by particularly irreducible ores.

We built our second furnace on a modular system (Fig 1). This allows us to explore many different furnace configurations by varying shaft heights and tuyere heights. Our first truly satisfactory bloom resulted from an attempt to make cast iron by increasing shaft height, fuel:ore ratio and, perhaps most significantly, air flow. From this serendipitous beginning, we have evolved a very efficient smelting regimen based on minimal furnace preheating, airflows from 1200–1600 litres/minute, the recharging of tapped slag, and the recycling of residue from the previous smelt.

Experiments 21–27 have all been run in a very similar manner. This paper will describe smelt 25 as typical of this series. This experiment has the benefit of especially good notes from the smelt, and the bloom is preserved and sectioned as a specimen. We then describe a smithing experiment with a similar bloom from smelt 26, a portion of which was forged to a billet and then to small 'currency' bars using manpower for forging and charcoal as fuel.

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