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Steelmaking ceramics from Cyfarthfa Ironworks coking plant, Merthyr Tydfil

Dr Tim Young
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Dr T.P. Young

Abstract

The material comprises a collection of ten Bessemer converter tuyères. Nine of the tuyères are used discards of a type associated with Cyfarthfa Steelworks (approximately 1882-1919) and of which examples have also been recovered recently from the Ynysfach Ironworks and from the Cyfarthfa Ironworks Stables.

A single example of an unused short tuyère is of a different design. It is only 227mm in length and bears the usual pattern of nine bores employed at the Cyfarthfa works, but they are only 9mm (3/8 inch) in diameter, as opposed to the usual 12mm bores (½ inch diameter) employed on other Cyfarthfa Bessemer tuyères. The purpose of this piece is unknown; it is very much shorter than documented types of tuyère for Bessemer converters and may either be for an unusual converter or perhaps might be a test piece from the brickworks.

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Methods

The assemblage comprises ten unstratified examples of tuyères from the Cyfarthfa Coking Plant Site (the former Thorn Electrical site). The catalogue of material is presented as Table 1.

The collections derive from excavations and a subsequent watching brief by the Glamorgan-Gwent Archaeological Trust in 2013-14. The site comprised extensive remains of the coking plant of the steelworks period (1882-1919), together with fragmentary remains of the earlier coking ovens and yard.

The project was commissioned by Rowena Hart of the Glamorgan-Gwent Archaeological Trust.

Results

The Bessemer Convertor tuyères from the Cyfarthfa Coke works fall into two groups.

Type 1: these fragments are up to 240mm in length, with no complete examples. All of these tuyères have been used and the distal ends commonly show erosion, widening of the bores and commonly slag or iron plugs.

The tuyères widen gradually from approximately 155mm diameter distally (at approximately 220mm from the base), to approximately 160mm at 45mm above the base (some examples may be slightly narrower). At this point the tuyère widens rapidly with a convex 'knee' shaped flare, with a then gently tapering short length to the base, which is of 180-190mm diameter.

There are nine bores, eight in a circle of approximately 85mm diameter and one centrally. The arrangement of bores is always somewhat irregular. Each bore is typically approximately 12mm in diameter (½ inch) for most of their length, flaring to 15mm (occasionally 20mm; 5/8 inch to ¾ inch).

Type 2: a single complete, unused, tuyère is short (227mm) and narrow. It is 140mm in diameter distally and widens progressively with a simple, angled, proximal flare to a basal diameter of approximately 180mm. The bores have the same pattern as in Group 1, but are narrower, being 8-9mm distally (5/16 inch), with a flare to approximately 17mm diameter at the base. On both proximal and distal ends there are arcuate impressions of the tool used to create the bore, with a diameter of approximately 30mm. On the basal surface, a deformed, and slightly raised, zone 6mm wide surrounds each of the flared bores. The tuyère shows some significant longitudinal flaws in the ceramic, which may have been the reason for its discard.

Discussion

This assemblage of steelmaking ceramics complements other collections from the Cyfarthfa Steelworks that have been described recently.

Tuyères from Bessemer converters, closely resembling the Type 1 examples here, were recovered both at Ynysfach Ironworks (Young 2014a) and at the Cyfarthfa Ironworks Stables (Young 2014c). The collections all differ in minor details, but share the same overall design of nine bores. The minor differences indicate variations in the manufacturing process. It is not known whether there is any chronological significance to the variations.

There appears to be little documented use of nine-bore tuyères in other works in the late 19th century (no examples were provided in the data tables of Fitch, 1882, Table 196). There is some documentation over the change towards larger bore sizes. The Type 1 tuyères from the coking plant, together with those from Ynysfach, employ a ½ inch bore, as opposed to the 3/8 inch bore of the examples from the Cyfarthfa Ironworks Stables. Fitch (1882) described ½ and 5/8 inch bores as a new development and indicates some relationship between their use and the development of Gilchrist Thomas (Martin) process of basic steelmaking. Cyfarthfa Steelworks was designed by Edward Williams of Bolckow, Vaughan and Co, Middlesbrough (Ince 1993), who had then only recently commenced with the Gilchrist Thomas process (1879) at their new steelworks in Eston – and so may well have investigated use of larger bores. Indeed, a commemorative wall at Eston, the 'Pikelet Wall' incorporates many 9-bore tuyères from the Eston works (https://www.flickr.com/photos/teesarchaeology/3855611642/ accessed 30/12/14) ,where Bolckow, Vaughan and Co. operated their own 8-ton converters, alongside their basic converters.

A more complete account of the contemporary discussion surrounding tuyère bore area and size was given by Young (2014a, 18), but it would appear that taken overall, the Bessemer implementation at Cyfarthfa reflects only a slight development from the seven-bore Bessemer designs of the 1860s.

The lack of different designs of tuyères from the various sites associated with the Cyfarthfa steelworks, gives support to the limited documentary evidence that the rather conservative design of the Bolckow, Vaughan and Co. 8 ton converters at Cyfarthfa was maintained throughout the life of the steelworks. This would have contributed to the degree of obsolescence of the Cyfarthfa Steelworks by the early 20th century.

The single Type 2 tuyère is a much more problematic object. The piece is far too short (227mm) for a functional tuyère for a Bessemer converter (typically approximately 600mm long in early converters). The piece also lacks a significant basal flare in its profile, compared with the Type 1 tuyères. Although it is conceivable that this object had a different practical, the fact that this is the only unused example may suggest that it was a non-functional item – perhaps a test piece formed during setting of the jig to bore the tuyères at the brickworks.

The steelworks ceramics items are an important addition to understanding and should therefore be retained and deposited as a part of the site archive in its eventual repository. Representative examples of the two types should be illustrated in the publication of the site.

References

FITCH, T.W. 1882. *Bessemer Steel. Ores and Methods*. St. Louis, 125pp.

INCE, L. 1993. *The South Wales Iron Industry 1750-1885*. Merton Priory Press, Merton. OWEN, J.A., 1972. The history of the Dowlais Ironworks 1759-1936, Merthyr Tydfil Borough Council, 80pp.

STOUGHTON 1908: *The Metallurgy of Iron and Steel*. McGraw-Hill, 537pp.

YOUNG, T.P. 2014a. Archaeometallurgical residues from Ynysfach Ironworks, Merthyr Tydfil. *GeoArch Report 2013-29*. 214pp.

YOUNG, T.P. 2014b. Archaeometallurgical residues from Ffos-y-fran, Merthyr Tydfil. *GeoArch Report 2014-23*. 5pp.

YOUNG, T.P. 2014c. Steelmaking ceramics and other archaeometallurgical residues, Cyfarthfa Ironworks Stables, Merthyr Tydfil. *GeoArch Report 2014-25*. 4pp.

Table 1: Summary catalogue

#	length preserved	diameter at base	other diameter	basal flare	bore distal	bore at base	bore circle	
1	165mm		146mm at 165mm	convex 'knee', 45mm tall	12mm (1/2 inch)	15mm (5/8 inch)		
2	125mm				12mm (1/2 inch)	15mm (5/8 inch)	85mm	
3	270mm	182mm	142mm			15mm (5/8 inch) with 1 inch countersinking		
4	195mm	190mm				15mm (5/8 inch)		
5	140mm	187mm			12mm (1/2 inch)	15mm (5/8 inch)		
6	210mm							
7	180mm	182mm			12mm (1/2 inch)	15mm (5/8 inch)		
8	235mm	180mm				15mm (5/8 inch) flaring to 25mm		
9	240mm					funnel shaped		
10	227mm (entire)	180mm	140mm at top	simple angular flare	9mm	15mm (5/8 inch), with 6mm deformed clay around	85mm	30mm marks around bore

Table 2: Comparison of Bessemer converter tuyères from Merthyr Tydfil.

Locality	Number	Number of bores	Bore diameter	Bores near base	External flare	Length
Ynysfach Ironworks (Young 2014a)	2	9	10-12mm (<1/2 inch)	Not flared	Angled	>260mm, distal end not seen
Cyfarthfa Coking Plant (Type 1)	9	9	12mm (1/2 inch)	Flare to 15-20mm in 25mm above base	Sigmoidal knee	>240mm>
Cyfarthfa Coking Plant (Type 2)	1	9	9mm (3/8 inch)	Not flared	Slight angle	227mm
Cyfarthfa Ironworks Stables (Young 2014c)	16	9	9 mm distally (3/8 inch)	Flare to 15-20mm in 25mm above base	Angled	>300mm, distal end not seen
Ffos-y-fran, 'Overbridge' site (Young 2014b)	2	13	9mm (3/8 inch)	n/a	n/a	>160mm, neither end seen

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geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6,
Western Industrial Estate,
Caerphilly,
CF83 1BQ

Office:	029 20881431
Mobile:	07802 413704
Fax:	08700 547366
E-Mail:	Tim.Young@GeoArch.co.uk
Web:	www.GeoArch.co.uk