British Flame

Power and Knowledge behind the Flame

The Newsletter of the British Flame

Winter 2004

www.BritishFlame.org.uk.

Chairman's Column

Roger Dudill reflects on the Birmingham TOTeMs and IFRF Joint Committee Meeting and where you should be in May

Birmingham became ***the place to be*** during November when IFRF and British Flame held TOTEMs 26 and 27. Around 60 delegates attended the two-day meeting at which the first half was dedicated to airing the many issues surrounding CO2, under the chairmanship of Nick Otter of Alstom Power Technology. Jim Seebold , formerly of Chevron-Texaco chaired the second day's presentations and discussions covering challenges and opportunities in the chemical and petrochemical industries. The meetings were highly successful and well received by the delegates, who included many international visitors. British Flame sponsored attendance by several combustion engineering students from both Cardiff University and University of Glamorgan – continuing our initiatives to promote educational and networking opportunities within our profession.

British Flame also hosted the year-end meeting of the IFRF's Joint Committee (JC), which preceded the TOTEMs. The JC is the board of directors of IFRF and is predominantly made up of a representative member of each of the National Committees. These twice-yearly meetings review and plan all aspects of IFRF activities, and as such are the prime opportunity for national opinions to be represented. British Flame hosted a dinner following the meeting, providing our colleagues from as far a field as Japan and the USA with a taste of British hospitality.

The success of such events is due in no small part to the efforts of those involved in organising the almost infinite details. This burden was willingly and ably handled by Jeff Rhine who, I know, freely gave up considerable time to ensure a smooth operation. Our gratitude goes to Jeff for his invaluable contribution.

For 2004, the next ***place to be*** will be Noordwijkerhout in May when the 14th Members Conference will be held. Established members will know that this event is the highlight of the Triennial at which the results from the previous triennial's programmes will be presented, and details of the following triennial discussed, **plus** the best opportunity to meet, work and socialise with old and new colleagues from around the world.

Do try to make it to the meeting; I know you will find it worthwhile.

Neil Fricker takes up his appointment as the IFRF Deputy Superintendent of Research

Neil Fricker, currently a member of British Flame's Council, has recently been appointed as IFRF Deputy Superintendent of Research. Neil's role will be to:

- determine the technical priorities that should be addressed in the future IFRF Members R&D programme
- prioritise these needs in terms of the funds and facilities available to respond to them
- present the results as an R&D programme for execution during the IFRF Triennial commencing in 2007, when he will become the Superintendent of Research.

In addition to activities relating to the future R&D programme within the IFRF, the Deputy Superintendent of Research sits on the newly reconstituted Monitoring Council of the IFRF. In this role, it is Neil's intention to seek the views of members on how best to realise value from the current IFRF research programmes undertaken with the support of members' funding.

Neil would welcome comments from and contact with any British Flame member wishing to express views or discuss needs regarding either the current or the future IFRF R&D Programmes.

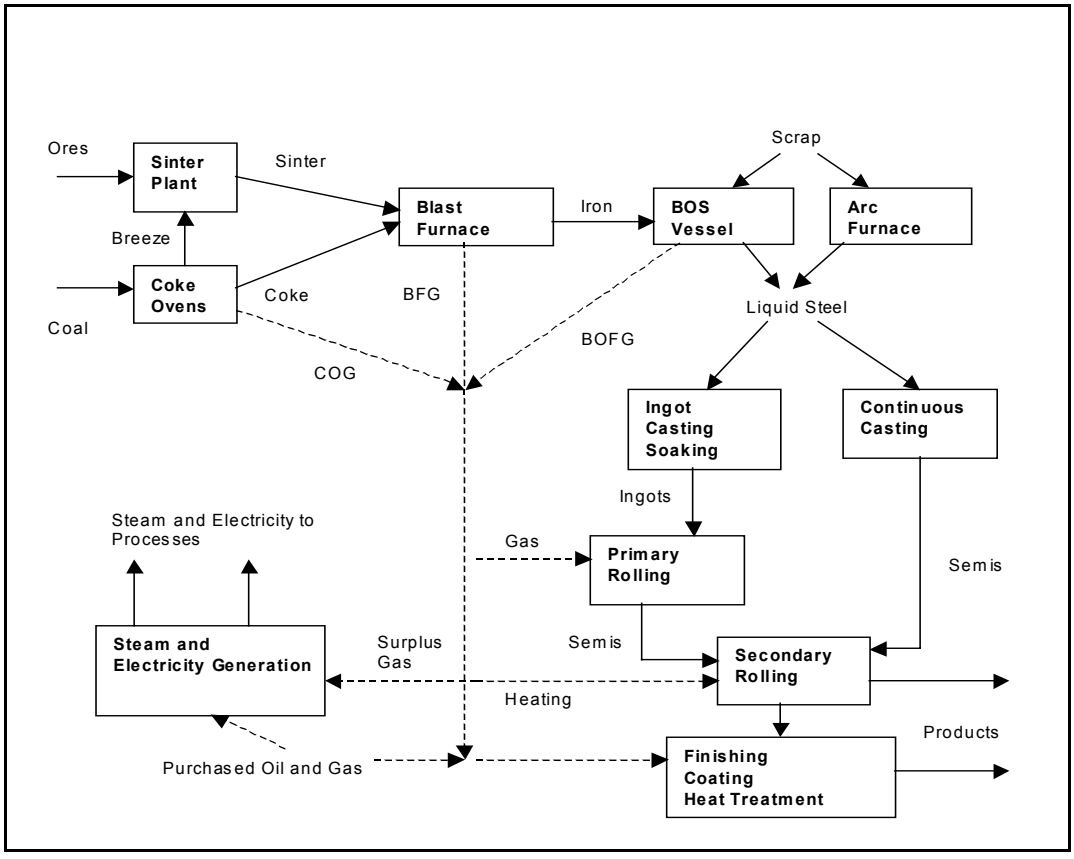
Neil can be contacted at Avalon Services, Tel 01564 773636, email neil.fricker@btinternet.com

Frank Fitzgerald, President British Flame, gives his views on how Flame Research can help the steel industry

(The article is based on the Presentation to TOTeM 25, Stockholm, 23rd October 2003. Frank is President of British Flame and had a long and distinguished career in the UK iron and steel industry.)

The process steps and main materials and fuel flows in steelmaking are shown in the diagram: full lines show materials flows and dotted lines fuel flows. Process steps indicated as single boxes may involve a number of pieces of plant, so in a works the process route and fuel flows are much more complicated. Major fuel flows (not shown) are needed for heating the coke ovens and the blast for the blast furnace. Some process steps are continuous, e.g. sintering, coke making and the blast furnace; and some intermittent, e.g. Basic Oxygen Steel (BOS) steelmaking, where for each BOS vessel a cycle of charge, blow, tap, occurs within the hour; and casting and finishing operations can be intermittent or virtually continuous.

Some processes generate fuel gases as by-products. Cokemaking gives a relatively high CV gas of roughly constant composition; the blast furnace gives a continuous flow of gas with a high nitrogen content and a CV so low that at times it will not burn without enrichment; and the BOS process, a gas of very variable flow rate and CV. Casting, reheating and finishing, and electricity generation consume fuels. The aim of the energy department is to use the by-product gases so as to minimise the purchase of fuels such as oil or gas and the need for flaring, by keeping the system as near balanced as possible. IFRF experience in the instrumentation field might be helpful.



COG – Coke Oven Gas

BFG – Blast Furnace Gas

BOFG – Basic Oxygen Furnace Gas

Manufacturing Routes to Steel

All the processes shown in the diagram involve flames and combustion to varying degrees (the table shows energy used per tonne of liquid steel produced). The development of some processes is relatively static; others are changing rapidly, e.g. heating furnaces. Some reheating furnaces when they were built, needed large enclosures to accommodate the flames necessary to get the energy input, but recent developments have led to much smaller furnaces, requiring less energy for heating from cold, fired by short flames with high preheat offering easier control of heat distribution and thus better product quality. The IFRF's HTAC (HEC) programme is relevant here. Also, in most works there is scope for improvement of the process steps, but it usually demands measurements on full scale plant using specifically designed probes and instrumentation, perhaps pilot plant studies, and physical and mathematical modelling aimed at predicting the outcome of changes. The IFRF has unrivalled expertise in all these areas.

There are two main drivers for improvement; first economics, the drive for greater profitability; and second, environmental considerations, following the Kyoto Protocol and the commitment of governments to reducing greenhouse gas emissions.

Operation	**Energy Consumption (GJ/tls)**
Coke ovens	2.4
Sinter plant	1.9
Ironmaking	11.45
Steelmaking	0.15
Continuous casting	0.1
Primary rolling	0.4
Secondary rolling	1.7
Finishing	1.3
Boilers / Power	1.6
Miscellaneous	0.2
Losses	0.45
Total	**21.7**

Energy Consumption for various Steelmaking processes

The control of operating costs is paramount in the drive for profitability. Ore and coal costs are outside the steelmaker's control. Of those costs, which the steelmaker can influence, energy costs are second only to the cost of labour. Thus more efficient use of energy, and particularly effective use of by-product gases, is essential in reducing the overall cost of making steel and IFRF Report G130/1/y examines this subject. Also, getting the job done properly first time avoids wasting energy by repeating any stage; and products have to be top quality to get top prices, which emphasises the need for furnaces and heating systems to be properly designed and controlled.

The drive to reduce greenhouse gas emissions also involves economics; emissions of CO_2 above an agreed level incur a financial penalty. The main process for reduction of iron ore is the coke based blast furnace and in an integrated steelworks some 90% of the bought in energy is in the form of coal, the vast bulk of it used as coke in the blast furnace. Coal ultimately appears as CO_2 in the atmosphere, and the steel industry thus has an inherent problem. Fuel injected into the blast furnace via the tuyeres reduces the coke requirement, and may reduce CO_2 emissions. The fuel can be PF, coarsely crushed coal, oil, gas, or any recycled combustible materials (IFRF trials used recovered plastics; domestic waste has also been suggested). Reduction processes not based on carbon do exist and sequestering the CO_2 produced might be considered but they are likely to lead to higher costs. Considering the worldwide distribution of coal reserves, the importance of the coke blast furnace seems assured for some years.

In conclusion, in the immediate and short term, reducing the costs of steelmaking and CO_2 emissions by the industry will be achieved by improving the efficiency of energy use, particularly the use of by-product gases. Further, a steel business will be successful only if the quality of its products is first class, which requires well-designed, well controlled finishing plant. These requirements will be satisfied in part by the application of the types of integrated studies in which IFRF has unrivalled expertise.

The papers and an overview of the discussion sessions from TOTeM 25 can be found in Combustion Trends, "TOTeMs" on IFRF.Net - *access is for Members only*

Flameless Combustion: the new HEC test facility now fully operational at the IFRF

(This article is based on a press release prepared by Jeff Rhine and published in a number of UK Journals & magazines.)

A new generation of high efficiency, low emissions burners and furnaces are becoming increasingly available through the development of flameless combustion technology. Flameless combustion can dramatically reduce oxides of nitrogen (NOx) emissions from furnaces utilising very high air preheat temperatures (~ 1000°C), thus giving operators the dual benefits of increased efficiency and lower CO_2 emissions. In addition, flameless combustion burner systems have shown to give uniform heat flux distributions, which can extend plant life, improve product quality and increased production rates.

To date, the main applications of flameless combustion have been limited to the iron and steel industries. However, there are many opportunities to utilise this technology in many other industrial situations, including chemical reformer, glass melting and gas turbine combustors.

Conventional high efficiency (high air preheat) burner

Same burner working in flameless combustion mode

(Photographs courtesy of Hotwork Combustion Technology)

Several manufacturers now offer flameless combustion burners, based on either recuperators or compact regenerators to recover the sensible heat from the furnace exhaust gases. However, the wider application of this new technology is held-back because surprisingly little is known about the principles governing combustion and heat transfer of flameless combustion/furnace systems. To meet this dearth of knowledge, and to provide design information to extend the technology to a wider range of industries, the International Flame Research Foundation (IFRF) has just commissioned a 1MWth semi-industrial scale furnace fired with a pair of regenerative flameless-oxidation burners.

HEC Furnace at the IFRF with NFK regenerative burners

The floor of the furnace can be easily modified to investigated different heat load profiles to reproduce various types of heating plant

The IFRF High Efficiency Combustion (HEC) furnace forms part of the €2 million, 4-year, development programme funded by the Members of the IFRF, Corus, Gasunie Research and Novem. The furnace has been designed to be very flexible allowing variable heat densities through adjusting its length and varying the heat sink to simulate different product requirements. The furnace is highly instrumented and has excellent access to the combustion chamber allowing

both conventional and laser-based instrumentation to be used to measure the flame(less) characteristics. These measurements will provide essential data for the development of flameless combustion design guidelines, including zone and CFD mathematical models to simulate the industrial furnace performance. Initially work will focus on natural gas as the fuel, but the facilities at the IFRF allow other gaseous and liquid/solid fuels to be investigated.

The new furnace was successfully installed and commissioned in 2003 and the initial trials have demonstrated it is meeting its design objectives.

Preliminary results from the commissioning tests were reported at TOTeMs 23, 24 and 25. The papers and an overview of the discussion sessions for these TOTeMs can be found in Combustion Trends, "TOTeMs" on IFRF.Net - *access is for Members only*

January 28th – A day to remember!!!!

(Some reflections by Jeff Rhine)

It was one of those days one always remembers!!! Do you remember where you were when John Lennon died…..? Will the 28th January 2004 have similar significance for mankind?

So what is so special about this day, I hear you ask? Was it the publication of the Hutton report and its consequences for Tony Blair and the BBC? NO! Was it the day that the Big Freeze eventually reached the UK and much of the country was grid locked? PERHAPS! (More about this later.) Or was it the day when DEFRA launched its consultation exercise for the EU Emissions Trading Scheme? YES!!!

For my edification I, along with 500 others, attended a Seminar on the EU Emissions Trading Scheme, and the UK's National Allocation Plan, held at the NEC in Birmingham. To try to explain what this will mean for UK industry and commerce would take many thousands of words. Fortunately, by the time you read this article, all the presentations will have been published on the DEFRA website – www.defra.gov.uk. Moreover, if you are own and operate one of the 1500 UK site that come under the Scheme, you will be very busy establishing you allocations and gaining your permit from the Environment Agency. Lets hope you are not one of the 600 missing sites and have missed the boat!

It is clear that the EU Emissions Trading Scheme is going to have a major influence on how industry and commerce carry out their day-to-day business and plan for the future. Whether or not it is going to be worthwhile, only time will tell. The Scheme, according to the presentations, will save 1.5 million tonnes of Carbon, about 1% of that emitted by the sites covered! It will mean, however, the UK meeting its *self-imposed* Kyoto CO_2 target of 16.5%: so another good day for New Labour. Without Trading we only save 15.3%.

But to be fair to the DEFRA and the presenters, I certainly learnt a lot about a very complex subject, not least coming to terms with many more acronyms:-

NAP – National Allocation Plan
UEP – Updated Energy Predictions or was that Updated Environmental Predictions?
NER – New Entry Reserve
GVA – Gross Value Added

As you can imagine there were many questions, particularly as the UK has to submit its plans to the EU Commission by October 2004 and the Scheme starts March 2005. As you might have guessed, this Country is we are pulling out all the stops to meet this deadline. But what about the other EU States and the newcomers – heaven only knows?? Considering the Scheme covers over 10,000 installations throughout Europe, it seems to be an impossible task to have everything in-place by next spring.

I think the UK is looking for a temporary get-out, but don't quote me on this. The EU Scheme allows for Temporary Exclusion arrangements. DEFRA is considering getting exemptions for participants in the current UK Trading Scheme and for industrial processes covered by CCA – Climate Change Agreements. This would give us an extra 12 months to get our act together and see if our European partners are playing ball – as if they wouldn't!! Anyway we can all sleep at night because it was made clear that Emissions Trading would not make us uncompetitive and security of supply was a key issue. So the lights will not go out and we will all have jobs to pay the extra 3% it will add to our domestic electricity bills. For me the Scheme could be a real opportunity – plenty of work for Consultants with emission validations, monitoring and much more!

This brings me back to my to where this article started. The NEC is usually about 30 minutes drive from my home. During the afternoon we had about 3cm of snow, followed by a severe drop in temperature. Returning home I did quite well reaching to within a mile from my house in 45 minutes. The rest of the journey was a real nightmare, taking me almost 3 hours to get to within150m of the house before abandoning the car in a side-road: not having moved at one stage for over 20 minutes!!! It was10.30pm before the traffic was freely moving along our road and I ventured out to rescue my car. So don't tell me about Global Warming. I am looking forward to warmer times and living closer to the sea – I am only joking!!!!

Dates for Diary

14th IFRF Member's Conference 'A Sustainable Energy Supply for Industry A Challenge for the IFRF', being held at Noordwijkerhout, the Netherlands on 11th-14th May 2004.

We would encourage British Flame Members to submit papers and / or posters for this International Conference. Members, particularly newly qualified & post-graduate students, are especially invited to present and discuss their research

activities with other Conference's Participants as "Work in Progress" in a poster format. Also there will be an opportunity to exhibit your products and services. The deadline for receiving proposals is 16th March 2004.

Download the proposal form now at:

http://www.combustion-centre.ifrf.net/meetings/mc/mc14/mc14ppf.pdf

The 14th Members Conference will be your opportunity to meet and discuss energy and environmental concerns with the international network of IFRF members. More information on the Conference can be found on the IFRF website.

5th European Conference on Coal Research & Its Applications, organised by the Coal Research Forum, is being held at University of Edinburgh on 6-8 September 2004. For further information contact Dr Alan Thompson at Nottingham University
Tel: +44 115 951 4198
Fax: +44 115 951 4115
Email:
alan.thompson@nottingham.ac.uk

British Flame is to co-sponsor the international exhibition **Foundry International**, being held in Birmingham at the NEC, in October 2005. The events is being organised by the publishers of Furnace International. We will send you more details later this year.

Some extracts of presentations from the 2003 AGM are attached

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