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Chris Taylor is a Fellow of the IVE with over 35 years enamelling experience and is a lecturer for the IVE Basic Approach Course.

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## THE VITREOUS ENAMELLEER

### JANUARY 2009

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**Official Journal of**  
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I am writing this editorial on September 1st with a raging thunderstorm continuing outside. We started off the year in the UK with the coldest winter on record for 20 years. This was set against a gloomy imminent economic forecast of depression and a rising toll of energy prices. We were promised (by the weather forecasters) a very warm and hot barbeque summer with plenty of sunshine. The whole of the summer occurred one week in July, unfortunately I missed it as I was on holiday in Rhodes, Greece at the time. The rest of the summer has been very poor with persistent rain.

I took early retirement in July of last year. Over the past 12 months I have had plenty of time to think back on my career in vitreous enamel and reflect on current world situations. I decided at the time to get away from the world of industry and concentrate on more leisurely activities. I have played golf for a few years now and have continued to do so but I have also taken to course fishing again with my 10 year old grandson. These last few months I have concentrated on fishing for carp at a local pool. My ambition now is to catch a specimen of 20lbs plus. So far I have managed to catch a fish of 10lbs but I will get the big one someday. I am also quite an avid reader of steam railway history and visit preserved steam railway centres whenever possible.

As I said above I have had plenty of time to reflect over the last 12 months and my 43 years involvement with vitreous enamel. I started working at J.A. Jordans in Bilston in 1966 in the laboratory under Chief Chemist Harold Clewes. In 1966 there were about 120 enamel processors and some 8 suppliers supplying frits and oxides (some of the processors having their own smelters) to the industry. All of the big manufacturers were in the UK at that time with some 50,000 gas or electric cookers being built per week. I moved on then in 1970 to Cannon Industries producing top of the range gas cookers and fires and worked initially in the laboratory and then onto shop floor production. This was very enjoyable as it involved dealing with the shop floor and still getting involved with technical problems. It was in the late 1970’s that the face of vitreous enamel changed due to technical innovation. The lay down automatic spraying units and the electrostatic vertical units were gradually replaced with
electrophoresis and powder plants. The pre-treatment plants using acids and nickel were replaced with degreased only plants due to environmental problems. I was at a seminar at Leeds University in 1970 which bought up the subject of enamel application at that time. I still have the notes from the seminar saying that electrophoresis and powder plants were many years away and were highly unlikely applications for vitreous enamel. What a change in 30 years!! I was involved in the electrophoresis plant at Cannon and have been involved in powder plant installations for many years. It was also about this time that the larger enamel manufacturers started to amalgamate and latterly move overseas. The frit manufacturers did likewise with many closing down altogether. I then moved on in 1987 to Escol Products where I worked for 21 years. This was very interesting for me as I learnt the basics of frit and oxide manufacture. I learnt a lot at Escol and over the past 15 years or so have travelled many times to Eastern and Western Europe and as far away as Taiwan. I have met with many excellent enamellers over that period of time and have been in some of the most modern enamel plants in the world.

Well I ask the question “Where do we go from here”? I am not sure about that question!! With the advent of various large enamel conglomerates moving out of the UK to Eastern Europe it is hard to see where the enamel industry is going. This is a mirror image of the motor cycle and car industries of a few years ago. To me it seems to be very easy to close down any area of UK industry under current UK legislation. It frightens me that more cookers are “badged up” and built up for the UK market now than ever before. I find it hard to understand how we can reverse this situation when we are in the middle of a recession and the banks are refusing credit. I find it very difficult to see how any further expansion of the vitreous enamel industry can occur. I give full marks to the current enamellers who both produce signs and cooker parts for staying in the UK. They must find it very hard under current economic conditions and the competition from Eastern Europe and China. I can only see that the level of vitreous enamel activity will stay at its current plateau for many years to come. The IVE is trying to raise the level of vitreous enamel awareness but it is very difficult without the backing of the industry users on seminars. We do need the enamellers to feed back their requirements to the IVE after all this is your industry representative.
Where do I go from here you may well ask. Well I do not miss getting up at 2.00am in the morning to catch a flight to somewhere in Europe, I do not miss the waiting around at the airports for late flights and I certainly do not miss the endless queues on the M6 motorway between Birmingham and Cannock. I do miss however, the friendship of colleagues and friends that I have met both competitors and enamellers over the last 43 years in the industry. Oh!! I forgot that 20lb carp.

PETER BOND
IVE Council Member

--ooOoo--
## EVENTS CALENDAR

### 13 October 2009 - 16 October 2009
**Primus: Household Appliances 2009**
- **Venue:** Kiev, UKRAINE
- **Contact:** Primus Ukraine
- **Tel:** +380 44 5376999
- **Email:** info@theprimus.com
- **Web:** www.primus.kiev.ua/en/ambiente-ukraine

### 19 October 2009 - 22 October 2009
**China Shunde International Exposition for Household Electrical Appliances 2009**
- **Venue:** Foshan, CHINA
- **Contact:** Koelnmesse GmbH
- **Tel:** +86-20-87552467 ext 19
- **Email:** g.liu@koelnmesse.cn
- **Web:** www.koelnmesse.cn/fair/Shundeexpo_EN/index.html

### 19 October 2009 - 23 October 2009
**5th International Congress on the Science and Technology of Ironmaking**
- **Venue:** Shanghai, CHINA
- **Contact:** Chinese Society for Metals
- **Email:** icsti@csm.org.cn
- **Web:** www.csm.org.cn/icsti09/en/

### 20 October 2009 - 23 October 2009
**CERAMITEC 2009: the 11th International Trade Fair for Ceramics and Powder Metallurgy**
- **Venue:** Munich, GERMANY
- **Contact:** Messe München GmbH
- **Tel:** (+49 89) 9 49-1 13 78
- **Email:** info@ceramitec.de
- **Web:** www.ceramitec.de/link/en/16746121
28 October 2009 - 31 October 2009  
Kitchen ODESSA 2009  
Venue: Odessa, UKRAINE  
Contact: Exhibition Center ‘Odessa Home’  
Tel: +380 (48) 728-64-94  
Email: expo@expohome.com.ua  

10 Nov 2009 - 12 Nov 2009  
17th Steelmaking Conference  
7th Ironmaking Conference  
1st Cleaner Production Seminar (IAS-JICA)  
Venue: Rosario, Santa Fe, ARGENTINA  
Contact: Evangelina Tielli,  
Instituto Argentino de Siderurgia  
Tel: +54 3461 461805 int 19  
Email: conferencia@siderurgia.org.ar  
Web: www.siderurgia.org.ar/

17 Nov 2009 - 19 Nov 2009  
Flurospar fo9  
Venue: Bilbao, SPAIN  
Contact: Victoria Cooper-Smith, Industrial Minerals  
Tel: 0207 779 8195  
Email: vcooper-smith@indmin  

20 Nov 2009 - 21 Nov 2009  
Hong Kong Tunnelling Conference  
Venue: Hong Kong, HONG KONG  
Contact: Guy Bridges, Institute of Materials, Minerals and Mining, Hong Kong Branch  
Email: secretary@iom3.org.hk  
Web: http://www.iom3.org.hk/
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**21 Nov. 2009 - 29 Nov 2009**

**UTILCASA 2009 (Trade Fair for Household Appliances, Kitchens and Houseware)**
Venue: Batalha, PORTUGAL
Contact: ExpoSalão
Tel: +351 244 769 480
Email: nfo@exposalao.pt
Web: www.exposalao.pt/

**01 Dec 2009 - 03 Dec 2009**

**1st Mediterranean Conference on Heat Treatment and Surface Engineering**
Venue: Sharm El-Sheikh, EGYPT
Contact: Egyptian Heat Treatment Society - EHTS and International Federation for Heat Treatment and Surface Engineering - IFHTSE
Tel: 202 25010172
Email: ehts@ehts-eg.org
Web: www.ehts-eg.org/
MANUFACTURERS MORE CONFIDENT ABOUT SHORT-TERM PROSPECTS, SAYS SURVEY

Manufacturers are feeling more positive about the economic outlook, according to research released yesterday (10 August) by business advisory firm BDO Stoy Hayward, which looked at confidence levels in the sector over the next six months. The survey of manufacturers in sectors as diverse as aerospace, food and automotive revealed that 37% of respondents were positive about confidence over the next six months, while fewer than one in seven (15%) were negative. Almost half of the respondents (48%) said their confidence levels were unchanged from the beginning of the year. Results varied by size, sector and location when it came to the question of whether margins would decrease, but in all 37% said they expected margins to fall, while 33% expected no change. Companies with turnover of less than £300m in the engineering, metal products and technology manufacturing sectors were most downbeat, with almost half expecting margins to slide. For all respondents, the most pressing issues were cash flow and sales. Companies also voiced a number of other concerns, including inability to insure debts and increasing government red tape. Tom Lawton, head of manufacturing at BDO Stoy Hayward, says: “The numbers overall are more positive than we were expecting, and there are indications that the sector is starting to improve, following an extremely difficult year. Manufacturers are having to work harder than ever to cope with the economic slowdown and issues such as falling sales and cash flow continue to weigh heavily on both large and small companies. It’s also interesting to note that a number of companies of all sizes cite government red tape as one of their biggest headaches.”

Source: Works Management Website (www.worksmanagement.co.uk) – August 2009
MANUFACTURING JOB COUNT FALLS TO RECORD LOW

UK manufacturing jobs fell to their lowest level since records began over 30 years ago, according to the latest official labour market statistics published by the Office for National Statistics today (15 July). The number of jobs in UK manufacturing now stands at 2.68 million, the lowest since records began in 1978 and a figure that reveals the loss of 201,000 jobs in the past year. And given that a recovery in employment invariably lags behind an upturn in the economy, the bleak jobs scene is likely to get worse before it gets better. Across the whole economy, the number of unemployed people, the unemployment rate and the claimant count have all increased and the number of vacancies has fallen. The unemployment rate was 7.6 per cent for the three months to May 2009, up 0.9 over the previous quarter and up 2.4 over the year – the largest quarterly increase in the unemployment rate since 1981. The number of unemployed people increased by 281,000 over the quarter and by 753,000 over the year, to reach 2.38 million. This is the largest quarterly increase in the number of unemployed people since comparable records began in 1971. The claimant count, which measures the number of people claiming Jobseeker’s Allowance, reached 1.56 million in June 2009. It has not been higher since June 1997. The redundancies level for the three months to May 2009 was 301,000, up 31,000 over the quarter and up 182,000 over the year. There were 429,000 job vacancies in the three months to June 2009. This is the lowest figure since comparable records began in 2001 and it is down 35,000 over the previous quarter and down 222,000 over the year. All sectors have shown falls in vacancies over the quarter with the largest fall occurring in finance and business services (down 16,000).


ENERGY TRACKER EXPOSES ENERGY PRICE VOLATILITY

The cost of energy has fluctuated wildly over the last two years, according to business advisor BDO Stoy Hayward’s quarterly manufacturing energy tracker. Electricity prices rose by 169% from the first quarter of 2007 to the first quarter of 2008. They reached a peak in the third quarter of 2008 at a price of £93.92 per megawatt hour but by the first quarter of 2009, costs had fallen back by a quarter.

Natural gas prices were also affected by global factors to reach a peak of £62.40 in the second quarter of 2008, a huge 207% increase on the same time
in 2007. Since then they have fallen to £43.1. Tom Lawton, BDO’s head of manufacturing said that while the net fall in the cost of energy was encouraging, the current unpredictability of the markets meant it was almost impossible for businesses to effectively forecast and make provision for energy costs. “The government is introducing a range of energy management regulations as part of the Climate Change Act which will be phased in over the next few years,” he went on. “For example, one of the foundations of the Act is the Carbon Reduction Commitment (CRC) which will impact larger users (consumption of more than 6,000 MWh of metered electricity per year). Registration to the CRC will be required during the period April to September 2010. Despite the fact this is yet more regulation manufacturers have to deal with, the hope is that this legislation will also enable significant cost savings as energy usage is reduced.” Lawton offered some tips for businesses hoping to minimise their exposure to fluctuating energy costs: The energy saving legislation will happen so savvy manufacturers should be ahead of the curve and look to take maximum advantage of the benefits from the new legislation

- Manufacturers will need to understand and adopt the (sometimes quite complex) energy saving schemes being introduced, such as the CRC. Guidance can be found on the websites for the Department of Energy and Climate Change and the Department of Business Innovation and Skills

- Companies should make all staff aware of the importance of the energy savings programme being introduced and the benefits available. There are many ways in which energy wastage can be reduced – the above web sites noted provide useful guidance

- Use forward purchases or forward purchase options to fix energy costs to the current lower price. However this does then pose a risk that prices do not move in the way expected and more costs are incurred

- Larger manufacturers could consider Combined Heat and Power (CHP) installations to make use of the heat derived from applications

*Source: Works Management Website (http://www.worksmanagement.co.uk) – June 2009*
THE VITREOUS ENAMELLER

CORUS CUTS 2000 JOBS

Steel company Corus has announced that it is to cut some 2000 mainly UK jobs because, the company says, “of the worldwide economic downturn and, in particular, the decline in steel demand in Europe and America”. The company, now a part of the Indian-owned Tata group, said it had already made significant cost savings since the downturn began, but several sites had suffered further deterioration in demand for their products. 2,045 jobs have been identified as being at risk. Some 1,500 of these are in the company’s production facilities: about 800 at the engineering steels sites, mainly Rotherham and Stocksbridge; about 370 in Corus Tubes in the UK and the Netherlands, and about 375 at downstream rolling and finishing plants in Teesside and Scotland. The company is also opening consultations on 500 white-collar jobs throughout the Corus Long Products division, the majority at Scunthorpe. Corus CEO Kirby Adams said: “We understand the difficulties these job losses are likely to cause our employees and their families. Any recovery in Europe appears to be some time off, so it is vital that we take this proportionate and responsible action now. We have to achieve long-term, sustainable competitiveness in a global and over-supplied steel market and are determined to do so by focusing on the quality of the products and services we offer our customers.” Commenting on the cuts, Business Minister Pat McFadden said: “This is very disappointing news for those affected. We understand the difficulties that the company is facing caused by an extreme downturn in demand for steel around the world. It is restructuring as it seeks to match production to lower demand and to position itself for to the future. “The Government is committed to ensuring UK industry has what it needs to tackle the challenges. We are working with Corus to try to secure the future for as many workers as possible. I met with Corus CEO Kirby Adams last week to discuss the pressures the company is facing as demand has failed to pick up with company projections. Lord Mandelson has also written to Corus to offer up to £5m of training support to secure jobs across Corus sites. “During discussions with Corus they have said the critical measures the Government can take are continued fiscal stimulus to support demand, particularly in construction and automotive. That is exactly what we are doing through Government capital expenditure in construction, measures to assist automotive companies and the car scrappage scheme to boost demands for new vehicles.

“Corus remains a substantial steel business, employing more than 20,000 in the UK and with capacity to produce over 13 million tonnes of steel per year. It remains important to many regions and communities in the UK.”

SMALL BUSINESSES IN MANUFACTURING FACE £1.2BN BILL FOR REGULATION

Smaller businesses in the manufacturing sector are left more than £1.2 billion out of pocket each year due to government red tape, new figures claim. Research carried out by business lobby and support group the Forum of Private Business (FPB) claims to have found that Britain’s small and medium-sized (SME) manufacturers face a £1,230 million annual bill to comply with legislation. The figure, derived from the results of the FPB’s quarterly Referendum survey of members, is based on the amount of company time, and therefore money, spent on government-imposed bureaucracy. It was found that recession-hit manufacturers are forced to spend an average of 35 hours of company time each month on form-filling and paperwork. Manufacturers with nine or fewer employees spend an average of 27 hours, those with between 10 and 50 employees spent around 50 hours and firms with up to 249 workers devote approximately 131 hours. In terms of costs, complying with health and safety legislation alone was found to leave small manufacturers £357 million out of pocket each year. The cost of complying with employment legislation was put at £320 million per year, comprised of dismissals and redundancy at £64 million, absence control and management at £55 million, maternity at £25 million, and disciplinary issues at £46 million. Meanwhile, the costs associated with legislation on employee holidays and any other remaining areas of employment legislation were put at £130 million. The legislation surrounding waste and the environment was calculated to cost £112 million, equality and diversity £35 million, ISO and industry standards £105 million, tax £221 million and building and property £80 million. Manufacturers in the South East face the biggest bill for overall compliance out of 12 regions identified by the Referendum at £153 million. Manufacturers in the West Midlands are hit with the second-largest cost at £133 million, followed by the South West (£132 million), the North West (£131 million), Eastern England (£127 million) and the East Midlands (£113 million). The Yorkshire and Humberside region’s cost was calculated at £112 million, followed by £102 million for Scotland, £76 million for London, £60 million for Wales, £51 million for Northern Ireland and £40 million for the North East. Peter Harlick a 75 year old FPB member who runs Eas Technology in Bury, Lancashire, which manufactures electrical equipment and employs three people, said the “soul destroying” burden of legislation had got “worse and worse” over the 40 years he has been in business.
He said new regulations appeared to be imposed on manufacturers almost on a monthly basis. “The situation now is disgusting. “The government wouldn’t know how to run a business. If they tried, I’m sure it would go bust very quickly. All this regulation is the most soul destroying thing they’ve ever done to small businesses.”

In July 2009 the UK voted positively on the draft to proceed to formal vote on the standard prEN15771 Vitreous and porcelain enamels - Determination of surface scratch harness according to the Mohs scale. The completion of the transfer and development of this standard from the tile industry is imminent and the standard will be adopted in the UK when it is published later this year.

Recent discussions on EN 15286 Vitreous and porcelain enamels – Terminology, have progressed and the document has now been sent to CEN for formal voting. This process closes in September 2009 and the UK will continue to support this standard. I would like to thank the project leader John Mullis for his efforts and hard work to conclude the development of the technical content. I would also like to thank the members of STI/36 for their positive contributions on the matter and I am sure the European enamelling community will see many benefits from common terminology.

The following international standards are due for review:

ISO 13805:1999 Vitreous and porcelain enamels for aluminium -
Determination of the adhesion of enamels on aluminium under the
action of electrolytic solution (spall test) - *Implemented by BSI as
BS EN ISO 13805:2009.*

ISO 13807:1999 Vitreous and porcelain enamels - Determination of
crack formation temperature in the thermal shock testing of enamels
for the chemical industry - *Implemented by BSI as BS EN ISO
13807:2009.*

The review process will be completed in October 2009 and if you have
comments on any of the above standards I would be grateful if you could
contact the IVE please.

We are also currently in the process of reviewing prEN ISO DIS 4534 - Metallic
and other organic coatings - Vitreous and porcelain enamels - Determination
of fluidity behaviour by fusion flow test. This is a parallel enquiry in ISO and
CEN and voting on the draft international standard is required in November
2009.

Finally I would like to inform readers that members of the STI/36 Committee
are scheduled to meet in late October 2009. If you have any standards related
questions or queries, or would like the Committee to discuss any particular
standards matter I would be grateful if you could forward details to the IVE
please. The members of STI/36 currently meet on an annual basis so please
take the opportunity to raise any matters if necessary.

SAQLAIN ALI
Chairman STI/36
IVE Council Member
HSE ANNOUNCES NEW MIDLANDS REGIONAL DIRECTOR

Rosi Edwards has been appointed as the new Regional Director for the Health and Safety Executive (HSE) in the Midlands. She has taken over the top job after seven years as Head of Operations for the Construction Division for Midlands, Wales and the South West. In her new role she will oversee the work of HSE’s staff dealing with a wide range of activities including manufacturing, education and health services across both the West and East of the region. Her predecessor, Nick Ratty, has moved to the HSE’s operational policy unit in Manchester. Ms Edwards said: “There is a common misconception that HSE is there to hamper businesses, to control them with ever more stringent rules and regulations, but this is simply not the case. Our role is to ensure that every employee and member of the public can go about their daily lives in as safe an environment as possible. There are still too many firms that needlessly put people at risk by failing to follow easy and straightforward practices and it is these businesses we need to target.” “With my new team, I want to work closely with colleagues in Local Authorities, who are responsible for enforcing health and safety in a wide range of premises, including shops and offices, to make sure we are using our resources to target the activities which really are a risk to workers and the public.” In 2007/08, in the West Midlands region, there were 18 deaths and more than 2,500 reported major injuries to employees, plus a further 11,000 injuries keeping employees away from work for more than three days. HSE’s five-year strategy that was announced earlier in the year set out how employees and employers should work together to minimise risks while maintaining business competitiveness. Ms Edwards will be supported in her role by Samantha Peace, starting as Head of Operations in the East Midlands in November and Peter Galsworthy who starts as Head of Operations in the West Midlands in October.

Source: Health & Safety Executive – August 2009
NEW PUBLIC CONSULTATION ON DRAFT GUIDANCE FOR ENVIRONMENTAL RETURNS FOR ALL ORGANISATIONS

The Department for Environment, Food and Rural Affairs and Department of Energy and Climate Change have launched a public consultation on draft guidance for how UK organisations - both public and private sector - should measure and report their greenhouse gas emissions in a clear and consistent way, as required by the Climate Change Act. Climate change is the greatest environmental challenge facing the world today. Rising global temperatures will bring changes in weather patterns, rising sea levels and increased frequency and intensity of extreme weather. The UK’s Climate Change Act became law on 26 November 2008. It introduces the world’s first long-term legally binding framework to tackle the dangers of climate change. The two key aims of the Act are:

- to improve carbon management and help the move towards a low carbon economy in the UK;
- to demonstrate strong UK leadership internationally, signalling that we are committed to taking our share of responsibility for reducing global emissions in the context of developing negotiations on a post-2012 global agreement next year.

The Climate Change Act introduced legally binding carbon budgets which set a ceiling on the level of UK GHG emissions and in order to meet these budgets we will have to collectively reduce our total UK GHG emissions. The Government recognises that for organisations to take action to reduce their GHG emissions they must have the appropriate tools and guidance. Measuring GHG emissions is the first step to effectively managing GHG emissions. This guidance is focussed on supporting UK organisations to reduce their contribution to climate change by helping them to measure their emissions. You are not required to submit or otherwise make available the data produced in accordance with this guidance but it might be of interest to your stakeholders, for example, your customers and possibly to other businesses in your supply chain. This guidance is primarily aimed at large and medium sized businesses but can be used by all UK organisations that wish to measure and report their total GHG emissions (also known as corporate carbon footprint) for either internal or external reporting purposes. The consultation is on the Defra website and the deadline for responding is 7 August 2009. The final guidance, aimed at all UK organisations, will be published by 1 October 2009.

HSE WARNS BUSINESSES NOT TO BE MISLED OVER NEW LAW POSTER

The Health and Safety Executive (HSE) is warning businesses across Britain not to be duped into buying unnecessary and overpriced copies of its health and safety law poster. The poster is a fixture of every workplace in Britain and employers have a legal duty to display the poster in a prominent position or provide each worker with a copy of a Law pocket card. Both outline employer and workers responsibilities and where workers can seek advice. There is some evidence of misleading promotions wrongly claiming that the old poster must be replaced immediately and that the new law poster should be displayed on every notice board within the business’ premises. This is incorrect and employers could be led to believe that they are not meeting their legal requirements. Employers can check they have a genuine HSE law poster by checking the unique, serially numbered hologram on each poster. Vinny Kenny, from HSE said: “The information that is being sent out by some companies may be misleading under consumer protection legislation and we want to put a stop to it. If businesses receive any promotions relating to the Law poster or pocket card and are in any doubt about their authenticity they should contact HSE on 0845 945 0055 before parting with their money.” New versions of the health and safety law poster and an accompanying pocket card were launched in April and provide clearer information for workers about their right to have their health and safety properly protected. The Health and Safety Information for Employees Regulations allow businesses five years to switch to the new poster and pocket cards – they must be replaced by no later than 5 April 2014. Employers who choose to display the old poster after 6 April 2009 must make sure it is legible and keep the addresses of the enforcing authority and the employment medical advisory service up to date. The new law poster, pocket cards and Easy Read and Large Print formats can be ordered from HSE Books on: 01787 881165. The pocket card and Easy Read and Large Print formats can also be downloaded free of charge from the HSE web site.

Source: Health and Safety Executive – July 2009
FATAL INJURIES TO WORKERS IN BRITAIN AT RECORD LOW

The number of people killed at work in Britain has fallen to a record low, new figures from the Health and Safety Executive (HSE) reveal. Provisional data shows that 180 workers were killed between 1 April 2008 and 31 March 2009 – a rate of 0.6 per 100,000 employees – down from 233 in 2007/08 and 17 per cent lower than the previous lowest total of 217, recorded in 2005/6. Judith Hackitt, the HSE Chair, said: “We very much welcome any reduction in the number of workers being fatally injured and the fact that the number for 2008/09 is a record low. ““There is inevitably variation in the figures year on year, but we can take heart from the fact that Great Britain consistently has fewer fatal injuries than comparable industrialised nations in the rest of Europe.” “This statistical snapshot needs careful analysis to help us to understand underlying factors, including the impact of the recession.” “Statistics on fatal injuries do not give us the whole picture. Work-related ill health is a significant problem and accounts for four times more working days lost than workplace injury, so there is still a major challenge we all face to prevent death, injury and ill health in all of our workplaces.” “The number and proportion of workers being killed in the workplace is likely to reduce in an economic downturn. But we also know from the past that the number and the rate of fatal injuries increase when trading conditions pick up.” “These statistics are encouraging but there is no magic wand in health and safety. When those running organisations show personal leadership, and when workers are involved in tackling the risks that they face, safety can be improved and lives saved – that is how we can turn this encouraging sign into real sustained improvement.”

Sizeable falls have been recorded in some of the historically most dangerous industries in Britain.

- 26 fatal injuries to agricultural workers were recorded - a rate of 5.7 per 100,000 workers - a big reduction in the 46 recorded in 2007/08 and the latest five year average (40)

- 53 fatal injuries to construction workers were recorded - a rate of 2.4 per 100,000 workers - a significant fall from the 72 recorded in 2007/08 and average number of fatalities (70) for the previous five years

- 63 fatal injuries to services workers were recorded, a rate of 0.3 per 100,000, and a fall from the figure for 2007/08 (73) and the latest five year average (76)
• 32 fatal injuries to manufacturing workers were recorded, a rate of 1.1 per 100,000, representing a slight fall from 2007/08 (33) and the average for the previous five years (37)

The new figures show that compared with the latest data available for the four other leading industrial nations in Europe – Germany, France, Spain and Italy – Great Britain has over the last five years had the lowest rate of fatal injuries. These figures are the first fatal injury statistics to be published since the recession was confirmed in January 2009.

*Source: Health and Safety Executive – June 2009*

**WINNERS OF THE WATER EFFICIENCY AWARDS SHOW THE WAY WITH ACTION TO REDUCE WATER USE AND INCREASE PROFITS**

The Water Efficiency Awards is the leading scheme in England and Wales recognising the achievements of business in promoting water efficiency. Each of the nine winners demonstrated an innovative approach to saving water. Businesses currently use around 9.8 billion cubic metres of water each year - but nearly a third of it could be saved bringing £10 million savings a day - or over £3.5 billion each year. By 2050 climate change could reduce water supply by up to 15 per cent and with a predicted population rise of 20 million people at the same time, the amount of water in England and Wales will be stretched even further. Water efficiency in businesses is also an important contributor to carbon savings for the UK as the supply and treatment of water produces four million tonnes of CO2 emissions. The overall winner, of the Chief Executive’s Award, was Lafarge Cement UK that reduced its water use by 95 per cent and is now saving £14,000 a year in associated electricity costs at its Cauldon Cement Works in Waterhouses, Staffordshire by using an innovative water recycling system deployed in a Special Area of Conservation. Winners of awards in each category were:

**Water Shout Award supported by Ofwat**

- Gold - Save Water Save Money Ltd
- Silver - Yorkshire Water
- Bronze - Anglian Water
Water Save Award supported by the Food and Drink Federation

- Gold - Lafarge, Cauldon Cement Works, Staffordshire
- Silver - Jaspers Ltd, Launceston
- Bronze - Essex & Suffolk Water

Water Solve Award supported by Defra

- Gold - Berkeley Homes, London
- Silver - United Utilities
- Bronze - Reigate & Banstead BC & Sutton & East Surrey Water

Chief Executive’s Award

- Lafarge, Cauldon Cement Works, Staffordshire

Dr Paul Leinster, Chief Executive of the Environment Agency said: ‘At a tough time for business it’s a pleasure to see such a high calibre of entries with so many organisations committed to improving their water efficiency.’

Source: Environment Agency – August 2009

WASTE TURNED INTO NEW MATERIALS

Millions of tonnes of common types of industrial and commercial waste can be turned into useable new materials and save businesses time and money. Four waste types were chosen by the Waste Protocols Project Team from 15 applications submitted by business and industry. Applicants were asked to provide information about what the waste is like, how much of it is currently being produced, how much it costs to dispose of and how much it’s worth once it has been recycled. The four waste streams were selected to be the focus for the fourth year of the Waste Protocols Project (2009/2010), a partnership between industry, the Environment Agency and the Waste & Resources Action Programme. They are:

- treated ash from the incineration of poultry litter, feathers and straw, which can be reused as a fertiliser, instead of inorganic fertilisers;
- non-virgin wood from post-industrial and post-consumer sources which can be used in place of virgin wood;
• cathode ray tube glass from televisions, computer monitors and other display equipment which can be used for aggregate in road construction instead of virgin sand or aggregate;

• compressed tyre bales which could be used as lightweight fill; for noise absorption or as a substitute for virgin aggregates.

In addition, the Aggregates Quality Protocol will be reviewed by the Project Team in conjunction with industry. Over the previous three years of the project, sixteen different wastes have been undergoing Quality Protocol development. To date, three Quality Protocols have been published as final documents: for compost from source-segregated biodegradable waste, for the production of processed cullet from waste flat glass and for the manufacture of secondary raw materials from waste non-packaging plastics. The fourth Quality Protocol, for the production and use of biodiesel is described in the previous news item of this newsletter.

Source: Environment Agency – August 2009

THE POLLUTER PAYS

New environmental damage and liability regulations force polluters to prevent and remedy environmental damage that they have caused - the ‘polluter pays’ principle. These regulations now cover the whole UK and came into force in:

• England - 1 March 2009
• Wales - 6 May 2009
• Scotland - 24 June 2009
• N. Ireland - 24 July 2009

If you or your business carry out an activity that causes environmental damage you will have to remedy the damage. If there is a risk of damage from your business activities, you must prevent such damage occurring. The regulations do not apply to environmental damage caused before they came into force and are likely to be used only for the most serious cases of damage. The regulations will ensure that the environment is fully protected against the most serious environmental damage. Prosecutions against polluters can take a long time to conclude and do not result in the damage being remedied. Under the regulations, environmental damage is:
• serious damage to surface or ground water
• contamination of land where there is a significant risk to human health
• serious damage to EU protected natural habitats and species or damage to Sites of Special Scientific Interest or Areas of Special Scientific Interest in Northern Ireland.

These regulations apply to:

• private businesses
• farming
• manufacturing
• construction and demolition
• waste management
• forestry
• public sector - schools, hospitals and government departments or agencies
• charitable and voluntary organisations.

If you don’t comply with the regulations, you can be prosecuted, fined and/or imprisoned. To find out more about these regulations and who enforces them see the NetRegs website.

Source: Environment Agency – August 2009

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METALLIC ENAMELS OF HIGH GLOSS, SMOOTHNESS AND COLOUR EFFECTS

The following paper by Naochika Iwata of Tokan Material Technology was presented at the XXI International Enamellers Congress, Shanghai, China - 2008

ABSTRACT

Alkali contents of porcelain enamel very often react with the surfaces of metallic pigments during firing at around 800°C., which results in a poor colour development. Therefore, a large amount of the pigments must be added to get a good colour development, but it loses glossiness substantially.

We have considered how to produce excellent metallic appearance of high gloss, smoothness and colour effects with the addition of a reasonably small amount of metallic pigments. The aspects considered are a) chemical compositions of enamel frit, b) selection of metallic pigments, c) milling formula to control surface waviness when sprayed and fired, d) selection of spray guns and application methods and e) firing conditions.

INTRODUCTION

Conventional metallic enamels are inferior to metallic paints in appearance in terms of metallic effect, glossiness and surface smoothness. We have planned to develop the metallic enamels which can produce excellent metallic appearance of high gloss and colour effects. In order to obtain the high gloss and colour effects, firstly we have studied chemical compositions of enamel frit, particularly less reacting with pigments as well as selection of metallic pigments which produce a good colour development.
Following examinations of frit and metallic pigment, we have studied application methods to improve surface smoothness. As a result, the development of metallic enamels of high gloss, smoothness and good colour effects was successfully done.

**IMPROVEMENT OF FRIT**

Alkali contents of porcelain enamel easily react with the surfaces of metallic pigments during firing over 800 degrees C., which results in a poor colour development. Therefore, a large amount of the pigments must be added to get enough colour development, but it loses glossiness after firing substantially. The frit newly developed can restrain the reaction with metallic pigments after firing and produce a good colour development with the addition of much smaller amount of metallic pigments (one-tenth in wt%). This also improves the glossiness of enamel surface. Excellent metallic appearance can be obtained with this frit at the firing temperature below 820 degrees C.

**SELECTION OF METALLIC PIGMENTS**

Four types of metallic pigments were prepared and enameled using a newly developed frit in the Metallic Enamels of High Gloss, Smoothness and Colour Effects using the same conditions. Brightness of each enamel surface after firing was observed by visual observation. Thermal changes were observed by DTA (Differential Thermal Analysis) to figure out the cause of variation of colour effect.

<table>
<thead>
<tr>
<th>Type</th>
<th>Colour effect</th>
<th>Average particle size (μm)</th>
<th>Thermal change (heating up to 900°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment A</td>
<td>good</td>
<td>90</td>
<td>Weight loss at around 750°C</td>
</tr>
<tr>
<td>Pigment B</td>
<td>poor</td>
<td>90</td>
<td>Transition point at around 580°C, start melting at 860°C</td>
</tr>
<tr>
<td>Pigment C</td>
<td>excellent</td>
<td>90</td>
<td>No change</td>
</tr>
<tr>
<td>Pigment D</td>
<td>poor</td>
<td>30</td>
<td>Weight loss at around 270°C, and then no change up to 900°C</td>
</tr>
</tbody>
</table>

*Table 1: Firing results of metallic pigments*
As a result, only pigment C has the excellent colour effect and pigment B is next. According to the measurement results of DTA, only pigment C is stable to heat with no heat change up to 900°C.

Fig. 1: Measurement results of metallic pigments by DTA
Shapes of the four pigments were observed by electron microscope. The shapes of the four pigments are similar in flake, and there is no significant difference. It is estimated that the thermal changes affected the colour effects of A, B and D judging from the measurement results by DTA.

**DIFFERENCES OF COLOUR EFFECTS BY COMBINATIONS OF FRIT AND METALLIC PIGMENT**

*(observed by electron microscope of 200 magnifications)*

Colour effects were examined using our conventional type of frit and newly developed frit, and pigment A and C.
**THE VITREOUS ENAMELLER**

**Fig. 3:** Differences of colour effects by combinations of frit and pigment

**Table 2:** Results of combinations

<table>
<thead>
<tr>
<th>Combination</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional frit and pigment C</td>
<td>△ some colour effect, but not enough</td>
</tr>
<tr>
<td>New frit and pigment C</td>
<td>○ excellent colour effect</td>
</tr>
<tr>
<td>Conventional frit and pigment A</td>
<td>X poor colour effect</td>
</tr>
<tr>
<td>New frit and pigment A</td>
<td>o good colour effect, but inferior to pigment C</td>
</tr>
</tbody>
</table>
Excellent colour effect was obtained with the combination of new frit and pigment C at 800°C and 820°C. The combination of new frit and pigment A also shows good results. It was confirmed that the new frit restrains the reaction with metallic pigments to a great extent.

**PROPERTIES OF NEWLY DEVELOPED FRIT**

Coefficient of thermal expansion: $293 \times 10^{-7}/°C (100 - 300°C)$ (FRIT)

Acid resistance (PEI citric acid test): AA (no mark).

Alkali resistance (10% sodium carbonate test): no mark

In developing frit, the following were studied subject to 2 coat application in consideration of how to meet three points, a) surface smoothness after firing, b) adaptability to various colours and c) high glossiness.

**MILLING FORMULA**

2 coat method is recommendable when using various metallic colours. The new frit was developed as top coat. Surface waviness often happens during spraying of metallic enamels. To solve this problem, selection of suitable base coat and milling formulas were inspected for pastel and dark colours.

**Example of milling formula of base coat for pastel colours**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frit A (low temperature type)</td>
<td>25</td>
</tr>
<tr>
<td>Frit B (middle temperature type)</td>
<td>75</td>
</tr>
<tr>
<td>Clay</td>
<td>0 - 5</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>0.2 - 0.4</td>
</tr>
<tr>
<td>Pigments</td>
<td>as required</td>
</tr>
</tbody>
</table>

**Example of milling formula of base coat for dark colours**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frit C</td>
<td>100</td>
</tr>
<tr>
<td>Clay</td>
<td>0 - 5</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>0.4 - 0.6</td>
</tr>
<tr>
<td>Quartz</td>
<td>0 - 10</td>
</tr>
<tr>
<td>Pigments</td>
<td>as required</td>
</tr>
</tbody>
</table>
Example of milling formula of top coat

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>New frit</td>
<td>100</td>
</tr>
<tr>
<td>Clay</td>
<td>0 - 5</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>0.4 - 0.6</td>
</tr>
<tr>
<td>Pigments</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Metallic pigment</td>
<td>as required</td>
</tr>
</tbody>
</table>

For the pastel colours, a good surface smoothness was obtained according to this milling formula when coated at 100μm thick even by direct-on application. Application of top coat further improves glossiness and surface smoothness.

PARTICLE SIZE OF FRIT

While average particle size of frit is normally around 20μm, it was ground to 10μm. Finer particle size increased surface smoothness after firing. Milling formula was rearranged to protect ageing of enamel slip.

SPECIFIC GRAVITY AND APPLICATION WEIGHT OF ENAMEL SLIP

Good surface conditions were obtained at 1.60 to 1.63 of specific gravity and 15 to 18 g/150cm$^2$ of application weight for both base coat and top coat. Specific gravity and application weight should be adjusted depending on temperature and moisture during operation.

APPLICATION METHODS

Coating tests were made only by manual spray application.

Type of spray gun: Low pressure atomization gun made by company D.
Spraying amount: 200-300cc/min.
Air pressure: 0.5Mpa
Spraying pattern: 150mm
Distance from gun to workpiece: 300mm

Smooth surfaces were obtained with the above conditions. Fine atomization by low pressure gun produces good surface and was less affected by firing. Workpieces were laid down and gun was operated in parallel to make even coating.
COATING THICKNESS

Coating thickness of 80 to 120 μm for base coat and 80 to 120 μm for top coat are recommendable.

FIRING CONDITIONS

2mm thick enameling grade sheet steel and a continuous furnace were used. Firing temperature and time were inspected. Conditions: Base coat: 820°C x 5.5 min. (in hot zone). Top coat: 810°C x 4 min. (in hot zone)

Smooth surface and the best metallic colour effect were obtained with the above conditions as per Figure 4. The left picture was taken diagonally and shows the surface sprayed and fired by conventional method. The surface is wavy. The right picture was taken diagonally, too. The surface sprayed and fired by improved method is not wavy.

Fig. 4: Comparison of fired surfaces
CONCLUSIONS

In order to obtain excellent metallic and smooth surfaces with high gloss and colour effects, a) development of new frit, b) selection of metallic pigment, c) modifications of milling formula and slip conditions of base coat and top coat and d) considering spraying and firing conditions were made. The following is a summary of the findings

1) The properties of pigment C does not change at 900°C and is able to obtain stable light reflectance compared with pigment A, B and D.

2) Newly developed frit is specially formulated to restrain reaction with metallic pigments. Optimizing milling formulas ensure excellent metallic colour effects at a firing temperature of 820°C or below.

3) Smooth surface can be obtained by modifying enamel frit, its particle size, application method, coating thickness and firing conditions.

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CURRENT STATUS OF ENAMELED MEDIUM PRESSURE REACTOR

ABSTRACT

This paper mainly discusses some special requirements in the design of medium-pressure enameled reactor, customary practices in the process of manufacture and inspection, and key points and applications of quality management.

The national standard of enamel glass (pressure vessel) has evolved from (1965 edition), 1969 edition, 1979 edition, 1992 edition to 2003 edition. There are 73 item standards about the products. The inspection standard of finished products, titled “Technical Conditions of Enameled Equipments” with standard No.HG2432 has also developed from 1979 edition, (1987 edition,) 1993 edition to 2001 edition and its latest edition is under establishment. The enamel pressure vessels are classed, according to their functions, into enamel stir vessel (detached type and closed type), enamel storage vessel (detached type, closed type and horizontal type) and enamel distillation vessel (detached type and closed type). In addition, there are enamel heat exchanger (disk type, bushed type and tube bank type), enamel column and enamel dryer etc. Enamel pressure vessels range from 300 to 3600 in diameter, from 50l to 80,000l in volume. They have nominal pressure of 0.25MPa, 0.6MPa and 1.0Mpa (according to under cylinder’s pressure, the same below) and working temperature from -20°C to 200°C. The standard doesn’t cover all specifications of products, e.g. up to 20,000l for enamel stir vessel in current standard and from 50l to 40,000l in new standard under consideration.
The manufacture of enamel medium-pressure reactor began from 1980’s because the process media made enamel reactors necessary. In Jiangsu and Zhejiang, our market research has found that enamel medium-pressure reactors are mostly used in the production of agricultural medicine and fine chemical, and scientific research. Our company is able to design enamel medium-pressure reactor up to 10,000l in volume so far and up to 20,000l later, including design pressure 1.6MPa and 2.5MPa. Temperature range is 0°C ~ 200°C. 1.6MPa series takes priority due to market demand. The design pressure in the jacket is 1.0MPa and the design temperature is 180°C.

Our company has made a research into the practicability of design technology of enamel medium-pressure reactor according to market demand. After preliminary designs, design software SW6-98 (The design and strength calculations are based on standard No.GB150.), together with reference to empirical formulas ($\delta \partial = 8D_i/1000+3$) and enamel design experiences, is employed for determinations of thickness, structures and scantlings of reactor body, jacket, transmission unit, opening reinforcement, sealing and hubbed flange. As to the design of hubbed flange, finite element method, in combination with standard No.JB/T4732, titled “Stress Analysis and Design”, is used for analysis of local stress of such flange and gasket. Connecting bolts are of clamp structure, using materials of 40MnB group and 35CrMoA group, quenched and tempered. Forgings are accepted, level II. If the pressure $\geq 2.5$MPa, using double-headed stud Group. Gasket is of expandable graphite compound gasket with carbon fibre around, which is pressed with expandable graphite braiding and metal corrugated ring. It has following mechanical properties: 8.5MPa to 10.0MPa for tensile strength, 20 to 30 for Shaw hardness, 70MPa to 110Mpa for compressive strength, 41% to 50% for compression rate, 36 to 50% for resilience rate. It has small thermal expansion coefficient. Gasket factor is 1.25 and specific pressure is 5. When necessary, PTFE or other materials are applied on the gasket. Therefore, the gasket is applicable in most acid and basic cases.

Design of shaft seal is a major technical problem in the design of reactor. Double-end balanced mechanical seal is used in our design. Pressure-balancing tank is attached. The materials of motion ring and static ring vary with working medium. Silicon carbide is suitable for most working medium. Silicon carbide is high in hardness, resistant to wear, good in self-lubrication and anti-oxidation, and low in thermal expansion coefficient. Flat surface degree can be treated
THE VITREOUS ENAMELLER

extremely to 0.02μm. It has mechanical properties as follows: 100HR for Shaw hardness, 60MPa for compressive strength, 500°C for working temperature, 75 MPa·m/s for permissible pv value. It meets design requirements in actual application.

In the transmission unit, pin-cycloid planetary reducer, BLD series, is employed with electromotor capacity of 0.55kw to 15kw corresponding to volume of 10l to 10,000l. Speed reducer takes double-pivot frame, HG21567-95 series.

Stirrer takes the form of gate, arm, impellor and propeller according to different media. The rotation speed usually is less than 200rpm. The straightness and vibration of shaft, and dynamic equilibrium of stirrer are specified.

It is specified in design procedures that design documents are signed by those engineers responsible respectively for design, check, standard, review and approval.

MANUFACTURE QUALITY CONTROL OF ENAMEL MEDIUM-PRESSURE REACTOR

1. Choice and quality of parent materials

Metallic materials, such as Q235-B, Q235-C, Q235-D, 20R, 16MnR and 08HT, are to be provided with quality certificates issued by steel mills. These materials are to be re-tested and also checked for appearance quality piece by piece. Q235-C and 16MnR are preferred as major materials over 16MnVR and other low-alloy or high-alloy steels from the point of view of rules, safety, enamel rigidity and economy.

2. Preparation of porcelain glaze

Traditional 3-in-1 ground glaze is used in our company. Finish glaze is different with process medium, which is to be resistant to acid and alkaline, and smooth in appearance. Compositions of glaze are as follows: SiO₂ (>65%), B₂O₃ (>15%), Na₂O (>10%), and Al₂O₃, K₂O, CaO, MgO etc. It is resistant to acidic media except those containing HF, F⁻, thick H₃PO₄ (concentration >30%, temperature >180°C), and alkaline media except strong alkaline (PH >12,
temperature $>100^\circ C$). The glaze resistance to alkaline and acid can be improved by adjusting concentrations of oxidants.

Table 1: Mechanical and Chemical Properties of Acid-resistant Glaze

<table>
<thead>
<tr>
<th>Acid-resistance g/(m² • d)</th>
<th>Alkaline resistance g/(m² • d)</th>
<th>Impact energy (J)</th>
<th>Thermal shock (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤0.40</td>
<td>≤3.0</td>
<td>≥230x10^{-3}</td>
<td>≥220</td>
</tr>
</tbody>
</table>

Enamel properties: 2.25 to 2.5 g/cm³ for density, 0.40 to 0.6 $\times 10^5$ MPa for elastic modulus, ≤220 for working temperature and ≥0.87 W/(m·k) for thermal conductivity.

3. Steel plate processing

The steel structure is designed such that the transitions are as smooth as possible and free of abrupt change. The processing of steel plate is as follows: blanking, forming (including head, nozzle, hand hole), joining, assembly, pre-heating, blasting, grinding (rough repair, fine repair).

4. Spray coating

Steel plate is spray-coated automatically or manually. Ground glaze is cold-sprayed and finish glaze hot-sprayed.

5. Enamel baking

Enamel baking is performed in vertical or horizontal-type electrical oven with automatic temperature control. Baking temperature is between from 900 to 960°C for ground glaze and from 880 to 940°C for finish glaze. Spray-coating times: 5 or 6 and coating thickness each spray: 0.18mm ~0.22mm. After completion of baking, enamel face is glossy and steel plate is baked completely without excessive baking. The baking process is related to temperature and time. Table 2 presents product specifications versus baking temperature and Table 3 presents product specifications versus baking time.
6. Metallic parts of equipments

Shell, head, hubbed flange, manhole flange, A and B-type nozzle and slip-on flange in accordance with HSB104-2006, with one process sheet for one work piece.

7. Assembly

Assembly of shell and hubbed flange, of shell and head, of upper and lower ring and inner shell, of head and hubbed flange, nozzles, manhole flange and frame base in accordance with assembly process sheet QR203.

8. Final assembly

In accordance with medium-pressure reactor final assembly process sheet QR203.

---

**Table 2: Ground Glaze Baking Temperature and Time**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Temperature (°C)</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500L (up to 500L)</td>
<td>900~925</td>
<td>21~25</td>
</tr>
<tr>
<td>1,000L~2,000L</td>
<td>920~940</td>
<td>26~35</td>
</tr>
<tr>
<td>3,000L</td>
<td>930~940</td>
<td>35~38</td>
</tr>
<tr>
<td>5,000L~6,300L</td>
<td>930~950</td>
<td>37~42</td>
</tr>
<tr>
<td>8,000L</td>
<td>940~960</td>
<td>43~48</td>
</tr>
<tr>
<td>10,000L</td>
<td>940~960</td>
<td>45~48</td>
</tr>
</tbody>
</table>

**Table 3: Finish Glaze Baking Temperature and Time**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Temperature (°C)</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 500L</td>
<td>880~920</td>
<td>17~24</td>
</tr>
<tr>
<td>1,000L~2,000L</td>
<td>900~935</td>
<td>25~30</td>
</tr>
<tr>
<td>3,000L</td>
<td>910~935</td>
<td>26~32</td>
</tr>
<tr>
<td>5,000L~6,300L</td>
<td>910~940</td>
<td>32~35</td>
</tr>
<tr>
<td>8,000L</td>
<td>920~950</td>
<td>37~40</td>
</tr>
<tr>
<td>10,000L</td>
<td>925~950</td>
<td>41~44</td>
</tr>
</tbody>
</table>

When baking, reactor head baking temperature and time should be a little less than that for reactor body. Baking temperature and time after 2-time glaze can be adjusted on the basis of above tables.
9. Co-operation parts

1) Manhole flange, hubbed flange are made of 16Mn, of 20 (Chemical elements S and P are controlled in content, S <0.020%, P <0.030%, especially C <0.19%). Forgings in accordance with JB/T4726-2002 and level II is acceptable.

2) Stirrer: For gate stirrer, shaft straightness is below 0.10mm/m. Shaft seal, bearing and shaft neck are mounted on the shaft with concentricity below 0.05mm. The radial amplitude of vibration is below 0.15mm at mechanical seal and 0.005Ln\(^{-1/3}\) or below (L: length of shaft below bearing, in mm; n: rotation speed, in rpm) at shaft end in accordance with Q/320400HB003 “Technical Conditions of Enamel Pressure Vessel”.

3) Thermometer pocket tube in accordance with HSB104-2006, its straightness below 0.15%L, where L is length of pocket tube.

4) The symmetry of shaft wing is 0.15%B or below in accordance with Q/320400HB003, where B is width of shaft wing.

5) After completion of manufacture, products are to be heat-treated unless stated otherwise in the technical agreement.

6) Quality standard of clips: HSB104-2006
   Material of upper clip forging: ZG45
   Material of lower clip forging: 40Cr
   Material of upper clip: 35CrMoA
   Material of lower clip: 30CrMo

   Destructive load of clip is not less than 160,000N with elongation of 15% at 87.5mm as destructive. Mechanical property is quality 8.8~11 and Brinell hardness 234~285.

7) Other manufacture quality control.

   Inspection sheets are prepared for manufacture processes for timely inspection according to drawings, process documents and welding procedure sheets. Besides, following standards are applicable:

   a) Carbon steel and low-alloy steel plate in accordance with GB/T699, GB/T700 and GB/T6654 respectively;

   b) Steel tube in accordance with GB/T8163;
c) For chemical compositions analysis of material, sampling in accordance with GB/T222 and analysis in accordance with GB/T223;
d) For tensile test, sampling in accordance with GB/T2975 and analysis in accordance with GB/T228;
e) For bend test, sampling in accordance with GB/T2975 and analysis in accordance with GB/T232;
f) NDT: Multi-echo UT is employed for testing of inner shell materials in accordance with JB/T4730.3 and level II is acceptable. Longitudinal and circumferential welds on inner shell are radiographed for 100% of weld length in accordance with JB/T4730.2 and level II is acceptable. Welds on jackets are radiographed for 20% of weld length or 250mm in accordance with JB/T4730.2, whichever is greater, and level II is acceptable table. Head nozzles made of coiled steel plate, less than 250mm in diameter, are subjected to magnetic particle test in accordance with JB/T4730.4 and level I is acceptable.
g) Testing of forgings: Clip forgings are tested in accordance with JB/T4385, level II forging, and subjected to magnetic particle test to the same extent as level II forgings hardness test in accordance with JB3965 and level III is acceptable. The testing of forgings of other parts is in accordance with JB4726.
h) For glass component and part, inspection in accordance with HG/T2637 “inspection method of geometry dimension about glass component and part”.
i) For head, test in accordance with JB/T4726;
j) For expanded graphite gasket of equipment and nozzle, inspection in accordance with HSB104-2006. Corrugations and radial grooves are not allowed on sealing face and laminations not allowed in through thickness. Gaskets are not allowed for re-use.
k) For double-end mechanical seal: inspection records, certificate of conformity and quality certificate are provided. Double-end mechanical seals are subject to hydraulic test and air-tightness test together with reactors.
l) Pressure test: The inner shell is subject to pressure test at 2.15 MPa (g) before applying enamel and at 1.6 MPa (g) after applying enamel. Hydraulic test is performed at 2.15MPa, followed by air-tightness test at 1.6MPa. Leakage, visible deformation and abnormal sound are not allowed during the test. Holding time of 30 minutes or longer is required in air-tightness test with no leakage.
m) Other quality inspections.
In our country, the production of pressure vessel is licensed. The manufacture licensing is to be possibly cancelled soon. After granted manufacture license of enamel products, the maker should be licensed for design and manufacture of corresponding class pressure vessel. Enamel medium-pressure reactor is classed as III class vessel in accordance with “Supervision Regulations of Pressure Vessel Safety and Technology” (1999 edition). Therefore licenses for A1 or A2 design and manufacture is required. So far only 3 companies are qualified for design and manufacture of enamel medium-pressure reactor in the enamel glass industry.

Total quality management is core of company management. The quality of design is the prerequisite of quality of finished product. Our company has established and improved 13 design management rules, i.e., designer qualifications, review and evaluation of designer job, job responsibility of designer, design procedures, compilation and review of design conditions, evaluation of design documents, management of design documents, revisions of design documents, re-use of design documents, specifications of design condition diagram, and use and management of design approval stamp. With reference to “Supervision and Management of Boiler and Pressure Vessel Manufacture”, our company has set up comprehensive quality management system in relation to quality control of enamel medium-pressure reactor. The system includes responsibility of manager, quality assurance system, documents control, business contract control, design control, purchase control, process control, heat treatment control, NDT control, physiochemical test control, pressure test control, co-operative parts control, metrological equipments control, non-acceptable parts control, quality improvement, training, implementation of “Regulations of Boiler and Pressure Vessel Manufacture Licensing”. ISO19001 (ISO9001) is incorporated into our quality system. In the same time, the company standard Q/320400HB003, titled “Technical Conditions of Enameled pressure vessel”, and it’s related part standard HSB104-2006 have been established for design, manufacture and inspection. The quality control covers design, manufacture and inspection. The whole process of manufacture is monitored and traceable for the quality. The non-acceptable products are separated strictly.

In the quality system, following standards are applicable:
1. Qualification of design of pressure vessel and pressure pipeline
2. Manufacture conditions of boiler and pressure vessel
3. Pressure vessel code “regulations of pressure vessel safety technology” (1999 edition)
4. Q/320400HB003-2003 — “Technical conditions of enamel pressure vessel”
5. HG2432-2001 — “Technical conditions of enamel equipment”
6. GB150-98 — “Steel pressure vessel”
7. GB/T222-2006 — “Allowable variation of chemical compositions of steel product”
8. GB/T223-2006 — “Chemical composition analysis of steel, iron and alloy”
9. GB/T228-2002 — “Tensile test at ambient temperature for metallic material”
10. GB/T229-1994 — “Charpy-V impact test for metal”
11. GB/T232-1999 — “Bend test for metallic material”
13. GB/T700-2006 — “Carbon structure steel”
15. GB/T5117-1995 — “Electrode for carbon steel”
17. GB/T5293-1999 — “Carbon steel wire and flux for submerged-arc welding”
18. GB20613-2000 — “Stud bolt”
19. GB20613-2000 — “Hexagon nut”
20. GB/T14957-1994 — “Steel wire for fusion welding”
22. JB/T4709-2000 — “Welding procedure specifications for steel pressure vessel”
23. JB/T4725-1992 — “Lobe-type base”
24. JB4726-2000 — “Carbon steel and structure steel forgings for pressure vessel”
25. JB/T4730-2005 — “NDT for pressure-containing equipment”
THE VITREOUS ENAMELLER

26. JB/T4732-2005 — “Stress analysis and design”
27. JB4744-2000 — “Mechanical test for production test plate of steel pressure vessel”
29. HSB104-2006 — “Standards for manufacturer’s parts”
30. Other standards

In present, enamel medium-pressure reactor is widely used in medicine industry, chemical industry, light industry, food processing, dyeing and printing, and scientific research etc. As we know, enamel reactors have been used in Nanjing Huaan Drug Company, Liaoning Huaduan Drug Company, Jiangsu Dengguan Pesticide Company, Zhenjiang Agrochemical Company, Zhejiang Xinganjiang Sanmu and Jingtanj Biochemical Institute etc. More and more enamel reactors are expected in use as the economy is growing and new materials are emerging.

REFERENCES
1. GB/T19001—“Quality management system”
6. HG/T20569-94 “Mechanical stir equipment”. Former chemical ministry, construction standard center
8. HG21563, HG21572-95 “Stirrer transmission”. Former chemical ministry, construction standard center
9. “Design guide to mechanical sealing”. Former chemical ministry, equipment design center August 1, 2007

--ooOoo--
EAS - EUROPEAN ACCEPTANCE SCHEME FOR CONSTRUCTION PRODUCTS IN CONTACT WITH DRINKING WATER

The following paper by Silvano Pagliuca of the International Enamellers Institute was presented at the XXI International Enamellers Congress, Shanghai, China - 2008

1. REASONS FOR EAS

In Europe there doesn’t exist a coherent normative legislation for construction of products in contact with drinking water. For the time being each Member State has its own regulatory arrangements together with either Standards or Voluntary Norms. The different regulations and local standards are creating barriers to free trade.

2. SCOPE OF EAS

The EAS will be a coherent and harmonized system in the EC market for regulating and accepting all the materials/products coming in contact with water for human consumption.

The EAS will cover construction products of the drinking water supply system from the last downstream point of the water treatment station to the consumer’s tap (including hot water systems).

3. MAJOR MILESTONES IN THE DEVELOPMENT OF EAS

- 1999 European Community SCC and SCDW accepting recommendations of MS.
4. EAS - HIGH LEVEL PRINCIPLES

EAS based on following main principles:

- High level of consumer protection and sound scientific base for public Health protection.
- Equal opportunities for all materials/products in contact with drinking water on the European market.
- Transparency of the EAS process.

5. EAS - A RISK BASED APPROACH TO PRODUCT ASSESSMENT

- Risk in Material Behaviour

  The potential risk for the materials in Products to leach harmful substances affecting Drinking water quality in term of:
  - Cytotoxicity
  - Colour
  - Odour
  - Turbidity
  - General Hygienic Aspects
  - Enhancement of microbial growth
The control strategies to be implemented against risks in Material behaviour are:

- full information in composition
- compliance of these Materials with PL (Organic Materials), CL (Metallic Materials), ACL (Cementitious Materials) and OCL (Glassy Materials/ Vitreous Enamels)

**Risk in Products Performance**

The impact of products on drinking water quality will depend also on their form and function.

The control strategies are implementing the evaluation of products parameters and related functionality such as:

- Surface to Volume ratios (S/V)
- Residence Time
- Lab Test Results vs. product operating conditions by means of Conversion Factors.

**6. EAS – THE FRAMEWORK FOR MATERIALS TESTING**

The EAS structure of materials testing is built on following 5 pillars:

- Compliance with PL, CL, ACL, OCL, as first line of defence for drinking water quality.
- Organoleptic Assessments consisting of:
  - Odour and Flavour
  - Colour and turbidity
- General Hygiene Assessments consisting of:
  - Total Organic Carbon
  - Chlorine Demand
  - Surface Organic Residues (metallic products)
- Toxic Substances
  - DW Parameters according to DWD 98/83/CE.
  - Drinking Water Positive List Limits (DWPLL)
  - Unsuspected Organic substances (by GCMS)
THE VITREOUS ENAMELLER

- Enhancement of Microbial Growth (EMG)

The behaviour of the material to provide Bio-film for Microbial Growth (table 1).

Table 1: EAS Matrix
Proposal for a matrix for EAS compliance criteria and testing related to materials

<table>
<thead>
<tr>
<th>EAS compliance criteria</th>
<th>Organic Materials</th>
<th>Metallic Materials</th>
<th>Cementitious Materials</th>
<th>Glassy Materials Vitreous Enamels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive lists</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Composition lists</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oxide Composition List</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Approved Constituent list</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Organoleptic tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odour and flavour</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Colour and Turbidity</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>General hygiene assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOC</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Chlorine demand</td>
<td>Yes</td>
<td>-</td>
<td>To be decided</td>
<td>-</td>
</tr>
<tr>
<td>Surface residues (metals)</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Substances posing a risk to health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DWD parameters</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PL substances</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Unsuspected substances (GCMS)</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>CL Compliance</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OCL Compliance</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Enhancement of Microbial Growth</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
</tbody>
</table>

7. EAS AND ISSUES IN PRODUCT TESTING

The test programmes recognize the different risks and performance characteristics of the different materials, but the approval and certification process applies to the products and not to materials. This is not a problem for single material products (e.g. plastic pipes), while different issues arise for more complex products such as:

- Assembled products, which may require independent components testing.
- Multi-layer products, which may require independent layer testing, if the layer in contact with drinking water is not acting as a perfect barrier to water and insulating deeper layers.
Site applied products, require representative samples for testing purposes. (ACL approach trying to simplify the assessment by means of an approved constituents list process).

The assessment of complex products may no require full testing in all circumstances.

When their impact on DW quality is insignificant due to:
- the very low contact surface
- the very high water volume
- very low residence time
- very suitable material type

a Reduced Assessment Procedure (RAP) may be applied.

8. EAS – THE LEGAL BASE

The legal base of the new EAS of products suitable for contact with water for human consumption was found primarily in the CPD 89/106/EEC and for drinking water parameters in DWD 98/83/CE.

CPD 89/106/EEC is under DG Enterprise responsibility, while DWD 98/83/CE is under DG Environment responsibility.

EAS requested to comply with CPD 89/106/EEC that implies the use of:
- CE marking
- Provision of product information
- Harmonized Product Standards (hENs)
- Harmonized Test Method
- The highest level of Attestation of Conformity (AoC) system (1+) which involves (table 2):
  - Third party testing, inspection and certification by Notified Bodies nominated by Member States.
  - Factory Production Control (FPC) system
  - Initial Type Testing (ITT)
  - Audit Surveillance
## Table 2: AoC

### Attestation of Conformity (AoC) SYSTEMS

<table>
<thead>
<tr>
<th>System</th>
<th>Task for Manufacturer</th>
<th>Task for Notified Body</th>
<th>Basis for CE Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>• ITT of product • FPC</td>
<td></td>
<td>Declaration of conformity of the Manufacturer</td>
</tr>
<tr>
<td>3</td>
<td>• FPC</td>
<td>• ITT of product</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>• ITT of product • FPC• (testing of samples according to prescribed test plan)</td>
<td>• certification of FPC on basis of initial inspection</td>
<td></td>
</tr>
<tr>
<td>2+</td>
<td>• ITT of product • FPC• (testing of samples according to prescribed test plan)</td>
<td>• certification of FPC on basis of initial inspection continuous surveillance, assessment and approval of FPC</td>
<td>Declaration of conformity of the Manufacturer based on certificate of conformity of FPC</td>
</tr>
<tr>
<td>1</td>
<td>• FPC • testing of samples according to prescribed test plan</td>
<td>Product certification on basis of: • ITT of product • initial inspection of FPC • continuous surveillance, assessment and approval of FPC</td>
<td>Declaration of conformity of the Manufacturer based on certificate of conformity of the product</td>
</tr>
<tr>
<td>1+</td>
<td>• FPC • testing of samples according to prescribed test plan</td>
<td>Product certification on basis of: • ITT of product • initial inspection of FPC • continuous surveillance, assessment and approval of FPC • audit testing of samples</td>
<td></td>
</tr>
</tbody>
</table>

### 9. SPECIAL FEATURE OF EAS

The EAS has special features that are not normally found in CPD 89/106/EEC:

- Requirements to comply with PL, CL, ACL, OCL
- Use of common test programmes which lead to a single pass/fail outcome
- Use of common Acceptance Levels

This conflicting area has to be cleared up by EG-CPDW/SCC/SCDW in the near future.
10. MANAGEMENT OF EAS DEVELOPMENT AND OPERATION

The EAS project management is carried out by means of following Work Breakdown Structure (WBS):

- **European Commission**
  - *Technical and Administrative Lead under the responsibility of DG Enterprise DG-Environment with DW function only giving Advisory positions.*
  - *table 3*

- **Supervisory Committees**
  - *Standing Committee on Construction (SCC)*
  - *Standing Committee on Drinking Water (Advisory Role)*
  - *table 3*

- **Advisory Committee**
  - *Regulators Group for Construction Products in contact with Drinking Water (RG-CPDW), recently replaced by Experts Group for Construction Products in contact with Drinking Water (EG-CPDW).*
  - *table 3*

- **Working Subgroups**
  - *Subgroup 1 for Organic Material (SG1-OM)*
  - *Subgroup 2 for Metallic Materials (SG2-MM)*
  - *Subgroup 3 for Non Metallic Inorganic Material (SG3--NMIM) (Cementitious and Glassy Materials)*
  - *Subgroup 4 for Assembled an Multi-Layer Products (SG4 - AMLP) (including Water Heater).*
  - *table 4*

- **CEN**
  - *Preparation of test method standards and harmonized products Standards under formal Mandate M 136 rev. of EC DG-Enterprise. CEN working with Its on work breakdown structure with a coordination Technical Committee CEN/TC 164-CPDW and Working Groups (WG\textsubscript{i} ) and Sub-Groups (AHG\textsubscript{j}).*
  - *table 5*

- **Notified Bodies**
  - *For Testing and Certification. MS requested to nominate NB in their own area of competence and responsibility. Representatives, of already nominated NBs, participate in developing EAS at EG-CPDW and SGs levels.*

- **Industry**
  - *Present as Observers/Experts in EG-CPDW and contributing to Sub-Groups activity. Participation in CEN Sub-groups*
Table 3:

CEN

D.G. Enterprise
Art.3,4 CPD
89/106 EEC

D.G. Environment
Art.10 DWD 98/83/CE

Mandate
M136

SCC
Art.19 CPD 89/106 EEC
MS 25

SCDW
Art.12 DWD 98/83/CE
MS 25

EG - CPDW

SG 1 - O.M.

SG 2 - M.M.
(including Glassy Materials)

SG 3 - N.M.I.M.
(including Water Heater Tank)

SG 4 - A.M.L.P.

Table 3 / OUTPUT:
European Assessment Scheme (EAS)
Reduced Assessment Products (RAP)
Accepted Without/Without Further Testing
Procedures (AWT / AWFT)
Directives

Correction Factors (CF)
Positive List (PL)
Composition List (CL)
Accepted Constituents List (ACL)

Oxide Composition List (OCL)
Attestation of Conformity (AoC)
CE Marking
Etc.
Table 4:

CEN/TC 164 - CPDW

WG 1

AHG 1
Organoleptic Test

SG 1 - O.M.

EG - CPDW

WG 2

AHG 2
Migration Test for N.M.I.M.

SG 2 - M.M.

WG 3

AHG 3
Microbial Growth

SG 3 - N.M.I.M.
(including Glassy Materials)

WG 4

AHG 5
Metallic Materials

SG 4 - A.M.L.P.
(including Water Heater Tank)

WG n

AHG 6
Cementious Materials

AHG 7
Unsuspected Materials GM/MS

All AHG n
Table 5: CEN Working Structure

D.G. Enterprise
Art.3,4 CPD
89/106 EEC

D.G. Environment
Art.10 DWD 98/83/CE

Mandate M136

CEN

TC 164 - Drinking Water Supply

WG 1 - Outdoor Systems and Components

WG 2 - Indoor Systems and Components

WG 3 - Effect of Materials in contact with Drinking Water

WG 4 - Concrete Pipes

WG 8 - Taps

WG 9 - Product for Water Treatment

WG 10 - Tanks and Boilers for cold and hot water inside buildings

WG 12 - Flexible Pipe (Assembled)

Wg 13 - Equipments for water treatment after Tap

WG 14 – Valves, joints, etc (inside building)
11. EAS AND MANDATE M136 TO CEN

DG Enterprise commissioned the Mandate M136 to CEN/CENELEC in 2001.

The Mandate deals with two areas of work:

- Supporting Standards (EAS Supporting test methods)
- Harmonized product standards (hEN)

The test methods are being developed by CEN/TC 164 WG3 dealing with Drinking Water Materials Behaviour and in liaison with EG-CPDW subgroups (1, 2, 3, 4).

The work structure of CEN/TC 164 WG3 breaking down in:

- AHG1-subgroup, developing Organoleptic Tests
- AHG2-subgroup, developing test for NMIM
- AHG3-subgroup, developing Microbial Growth Test
- AHG5-subgroup, developing MM tests
- AHG6-subgroup, developing Cementitious tests
- AHG7-subgroup, developing GC/MS analyses methods for unsuspected substances.

Among other CEN/TC 164 WGn, WG10 has to be also quoted because dealing with product standards of Tanks and Boilers for cold and hot water inside buildings.

For the harmonized product standards the Mandate indicated:

- The products/materials to be covered (Annex1)
- The product performance characteristics (Essential Requirements)
- The System of Attestation of Conformity

The harmonized product standards will have a ZA annex for Essential Requirements (CPD 89/106/EC), also giving details of Attestation of Conformity (1+) and Product marking Requirements. It is not clear at present how the detailed and complex testing and approval procedures are to be incorporated into product standards.

The ZA/EAS annex will give details of attestation of conformity “1+” (see table 2) and will introduce the EAS Logo that will be reported in the CE marking.
### Table 6: Annex 1 of M136 rev. Mandate

<table>
<thead>
<tr>
<th>FORMS</th>
<th>MATERIALS</th>
<th>PRODUCTS FOR CONSIDERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kits</td>
<td>As indicated below for components</td>
<td>Kits, composed of pipes and/or tanks, fittings, adhesives and joints, including their supports, to be used for the transport, storage and/or distribution of the water intended for human consumption.</td>
</tr>
<tr>
<td>Piping system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid components</td>
<td><strong>Cementitious materials:</strong></td>
<td>Pipes, coated or uncoated</td>
</tr>
<tr>
<td>Flexible components</td>
<td>(e.g. reinforced/fibred/unreinforced/prestressed precast concrete,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cement mortar lining with or without seal coat, polymer modified,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fibre cement, …)</td>
<td></td>
</tr>
<tr>
<td><strong>Metallic materials:</strong></td>
<td>(e.g. steel, aluminium, copper, alloys, cast/ductile.grey/malleable cast iron, …)</td>
<td></td>
</tr>
<tr>
<td><strong>Organic materials:</strong></td>
<td>(e.g. plastics, polymers, rubbers, elastomers, PVC, PE, …)</td>
<td></td>
</tr>
<tr>
<td><strong>Glassy, glass-like and ceramic materials:</strong></td>
<td>(e.g. glass, vitrified clay, enamel, …)</td>
<td></td>
</tr>
<tr>
<td><strong>Composite:</strong></td>
<td>(e.g. glass fibre reinforced polyester, carbon fibre reinforced epoxy resins, …)</td>
<td></td>
</tr>
</tbody>
</table>

### ANNEX 1 - FIELD OF APPLICATION *

*Construction products in contact with water intended for human consumption*

**LIST OF PRODUCTS INCLUDED IN THE MANDATE TO BE USED IN:**

- 19/33 SUPPLY OF HOT AND COLD WATER
- 33/33 STORAGE FIXTURES

* Under the provisions of both Council Directives 89/106 (CPD) and 98/83 (DWD), it is of the competence of the Member States to fix from which place the networks carry Drinking Water (e.g. from the last treatment plant). It is
understood that the DW distribution goes up to, and includes the consumer taps. Products specifically placed on the market for the purpose of being used in drinking water extraction, production and/or treatment by the water supplier, in installations for putting drinking water into tankers, bottles, or containers, or in any food-production undertaking for the manufacture, processing, preservation or marketing of products or substances intended for human consumption, are excluded from the field of application.

<table>
<thead>
<tr>
<th>FORMS</th>
<th>MATERIALS</th>
<th>PRODUCTS FOR CONSIDERATION</th>
</tr>
</thead>
</table>
| Components     | Cementitious materials:  
(e.g. reinforced/fibred/unreinforced/prestressed precast concrete, in situ concrete with or without organics, polymer modified, fibre cement, …)  
Metallic materials:  
(e.g. coated/mild/lined/stainless steel, aluminium, copper, alloys, ductile iron, cast iron, …)  
Organic materials:  
(e.g. plastics, rubber, …)  
Glassy, glass-like and ceramic materials:  
(e.g. glass, vitrified clay, enamel …)  
Composite:  
(e.g. glass fibre reinforced polyester, admixtures,…) | Tanks (including closed and vented hot water storage units) used in fixed installation for supply or storage of water intended for human consumption |
| Components     | Metals  
Rubber  
Plastics  
Glass, ceramics, enamels  
Composite  
Cast iron | Valves, taps, pumps, watermeters, protection and safety devices  
Coated or uncoated |
| Components     | Metals  
Rubber  
Plastics  
Chemical compounds | Fittings, adhesives, joints, joint sealings and gaskets |
| Malleable      | Composite | Membranes, resins |
| Flexible       | Composite | Coatings, including linings |
| Malleable      | Composite | Lubricants, greases |
The following Directives must be taken into consideration:

- 98/83/EC of 3 November 1998, known as the “DWD”.

12. EAS AND IEI CONTRIBUTION AND STRATEGY

IEI has been participating at the works of EAS as Observer on behalf of the European Enamelling Industry at RG-CPDW from the very beginning.

Several working documents were developed aiming at showing Vitreous Enamel fitness for contact with water for human consumption (see: www.iei-world.org).

When EG-CPDW replaced RG-CPDW, I.E.I. sitting in
- SG3-NMIM as Expert of Glassy Material/Vitreous enamel
- SG4-AMLP as liaison for SG3 and expert for Hot Waters Heaters.

IEI strategy has been to develop working documents to support:
- a Vitreous Enamel Oxide Composition List
- an Accepted Without Testing Procedure (AWT)
- a Reduced Assessment Product approach for water heaters

13. VITREOUS ENAMEL MIGRATION TEST STUDY

Recently, I.E.I. presented at the EG-CPDW plenary meeting a **Vitreous Enamel Migration Test Study** with following objectives:

- To prove that the Vitreous Enamel is a very insoluble and inert material, also in hot water (85°C)
- To issue an Oxide Composition List for Water Heater acting as a Positive List in the CPDW European Directive.
- To demonstrate by means of Migration Test, according to **EN 12873-1** test method, that Vitreous Enamel heavy metal in the leacheates are far below the Maximum Allowed Concentration (M.A.C.) of **DWD 98/83/EC**.
- To ask for an Accepted Without Testing (AWT) Procedure for Vitreous Enamel.
14. WATER HEATERS VITREOUS ENAMEL OXIDE COMPOSITION LIST (OCL)

Following Oxide Composition List was proposed to the European Commission the base of a very long and reliable “Prior Knowledge” of the Water Heater Market.

Table 7: Vitreous Enamel Oxide Composition List (OCL)

<table>
<thead>
<tr>
<th>Substance</th>
<th>Min</th>
<th>Max</th>
<th>Substance</th>
<th>Min</th>
<th>Max</th>
<th>Substance</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>40</td>
<td>80</td>
<td>MgO</td>
<td>0</td>
<td>2</td>
<td>Fe₂O₃</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>B₂O₃</td>
<td>5</td>
<td>15</td>
<td>CeO₂</td>
<td>0</td>
<td>15</td>
<td>MoO₃</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Na₂O</td>
<td>5</td>
<td>20</td>
<td>ZnO</td>
<td>0</td>
<td>10</td>
<td>P₂O₅</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>K₂O</td>
<td>0</td>
<td>5</td>
<td>Al₂O₃</td>
<td>0</td>
<td>5</td>
<td>SnO₂</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Li₂O</td>
<td>0</td>
<td>10</td>
<td>CoO</td>
<td>0</td>
<td>3</td>
<td>TiO₂</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>CaO</td>
<td>0</td>
<td>10</td>
<td>NiO</td>
<td>0</td>
<td>3</td>
<td>ZrO₂</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>BaO</td>
<td>0</td>
<td>5</td>
<td>CuO</td>
<td>0</td>
<td>2</td>
<td>F</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>SrO</td>
<td>0</td>
<td>5</td>
<td>MnO₂</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For following type of products:

- Water heaters/hot water tanks/boilers (working at 60-85°C);
  - As first objective and secondly
    - Storage Systems;
    - Pipes;
    - Valves;
    - Joints.

15. POTENTIAL RISK

Vitreous enamel is an inorganic glassy material with a very low solubility in water and, due to its chemical composition and physical structure, and on the basis of scientific studies and a very long prior knowledge, it can be stated that:

- T.O.C.: not applicable (n.a.), Vitreous Enamel is a pure Inorganic Material and is free from any organic product contamination, also due to the high temperature firing process (830 – 860°C)
- Odour & flavour: not applicable (n.a.), the product is free from any organic product which could affect these drinking water characteristics;
THE VITREOUS ENAMELLER

- Colour & turbidity: not applicable (n.a.), the material has a so low solubility that could not affect these drinking water characteristics;
- Enhancement of microbial growth: not applicable (n.a.) for absence of Bio-film, the product has a very smooth, clean and hard surface and the normal boiler working temperature is over 60°C.

A specific study demonstrates that vitreous enamel inhibits microbial growth (see document RGCPDW 123 “Comparative Bacteriological Studies”2;

- Migration test: an assessment of the migration of some elements according to DWD 98/83 CE could be necessary to prove the low leaching level of Vitreous Enamels for water heater.

These statements are fully in line with the test methods reported for glassy materials in the matrix for EAS compliance criteria and testing related to material types (Table 1).

16. A FEW EXAMPLES

Table 8: Boron

<table>
<thead>
<tr>
<th>Element Composition</th>
<th>M.A.C. (%)</th>
<th>B 1000 μg/l</th>
<th>DWD 98/83/CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element Oxide Cycle (24h)</td>
<td>I°</td>
<td>II°</td>
<td>III°</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Product</td>
<td>μg/l</td>
<td>μg/l</td>
<td>μg/l</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>F1</td>
<td>10,12</td>
<td>65</td>
<td>63</td>
</tr>
<tr>
<td>F2</td>
<td>10,39</td>
<td>63</td>
<td>61</td>
</tr>
<tr>
<td>F3</td>
<td>12,33</td>
<td>112</td>
<td>133</td>
</tr>
<tr>
<td>P1</td>
<td>7,80</td>
<td>115</td>
<td>90</td>
</tr>
<tr>
<td>P2w</td>
<td>8,70</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>P3</td>
<td>11,20</td>
<td>164</td>
<td>150</td>
</tr>
<tr>
<td>P4</td>
<td>9,77</td>
<td>124</td>
<td>100</td>
</tr>
<tr>
<td>C1</td>
<td>10,00</td>
<td>304</td>
<td>287</td>
</tr>
<tr>
<td>C2w</td>
<td>9,00</td>
<td>164</td>
<td>175</td>
</tr>
<tr>
<td>C3</td>
<td>12,00</td>
<td>311</td>
<td>288</td>
</tr>
</tbody>
</table>
Graph 1: Boron

Graph 2: Nickel
Table 9: Nickel

<table>
<thead>
<tr>
<th>Product</th>
<th>Composition</th>
<th>Cycle(24h)</th>
<th>Cycle(24h)</th>
<th>Cycle(24h)</th>
<th>Cycle(24h)</th>
<th>Cycle(24h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0,50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>F2</td>
<td>0,98</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F3</td>
<td>0,36</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P2w</td>
<td>0,40</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P3</td>
<td>1,95</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>P4</td>
<td>0,95</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>C1</td>
<td>0,00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>C2w</td>
<td>0,00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>C3</td>
<td>0,00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

17. GLASSY MATERIAL / VITREOUS ENAMELS ACCEPTANCE PROCEDURE FLOWCHART

HWT Vitreous Enamels, according to the EAS matrix, requested to comply only with:

1. OCL
2. DW parameters

European Acceptance Scheme procedure for contact with drinking water for these type of materials could be reported in the flowchart of Table D:
18. CONCLUSIONS

IEI migration study report stating following outcomes:

- HWT Vitreous Enamels containing following Elements: B, Ni, Cu, F, Mn, Ba, Co according to the proposed OCL, are proved to be very insoluble materials, both in distilled and spring crystalline water.

- Migration Rates at 85°C of above elements analyzed with testing method EN 12873-1 are far below the according MAC of DWD 98/83/CE.

- Also registered a very low leaching trend of other elements such as Ba, Co present in the OCL of HWT Vitreous Enamels but of no interest of DWD 98/83/CE.

- Residence time considered in “Mₙ₈⁵” calculation being 24h (1day).
Migration rates at low temperature (25°C) are expected to be much lower than those at high temperature (85°C) according with Arrhenius’ equation:

\[ M_n^T = e^{-\frac{E_a}{RT}} \]

- \( M_n^T \) = Migration rate at Absolute Temperature T
- \( E_a \) = Activation Energy (70 kJ/mol)
- \( R \) = General Gas Constant

and in line with the prior knowledge of the enamels and enamelling technology; hence, no need of further Migration Tests at lower temperatures (25°C and 65°C).

Vitreous Enamels complying with OCL are suitable for contact drinking water and can be accepted for contact with water for human consumption with an AWT procedure, according to the proposed Approval Procedure Flowchart.

EG-CPDW commission has to bring the I.E.I. working document along with all the eventual Expert Comments at the Steering Construction Committee (SCC) for final decision.

BIBLIOGRAPHY AND PREVIOUS CPDW DOCUMENTATION ON VITREOUS ENAMELS:

1. RG-CPDW 115: Comments concerning Enamelled Products
2. RG-CPDW 123: “Comparative Bacteriological Studies”;
3. RG-CPDW 165: “Detailed Boiler Presentation”
5. EG-CPDW 200 - ‘RG-CPDW186 Final EAS
8. TG-CPDW 06-007 (RS 036 rev.5) “Accepted Without Testing / Without further Testing (draft) Procedural Aspects.”

10. TG-CPDW 06 065A = TG DS 042A, Construct 06/763 “Construction Products in contact with water intended for human consumption”

11. RG-CPDW 14 Rev.1 Coordinated DWD/CPD Glossary of Concepts & Tools for the EAS


LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACL</td>
<td>Approved Constituent List for the European Acceptance Scheme</td>
</tr>
<tr>
<td>ATP</td>
<td>Adenosine Tri-Phosphate</td>
</tr>
<tr>
<td>AoC</td>
<td>Attestation of Conformity: refers to the CPD system for attesting the conformity of construction products to European Technical Specifications</td>
</tr>
<tr>
<td>AWT-AWFT</td>
<td>Accepted Without Testing-Accepted Without Further Testing</td>
</tr>
<tr>
<td>CEN</td>
<td>Comité Européen de Normalisation (European Committee for Standardisation)</td>
</tr>
<tr>
<td>CL</td>
<td>Composition Lists for the European Acceptance Scheme</td>
</tr>
<tr>
<td>CPDW</td>
<td>Construction Products in contact with Drinking Water</td>
</tr>
<tr>
<td>DG</td>
<td>Directorate General of European Commission</td>
</tr>
<tr>
<td>DWD</td>
<td>Drinking Water Directive (Directive 98/83/EC)</td>
</tr>
<tr>
<td>EAS</td>
<td>European Acceptance Scheme for CPDW</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EFSA</td>
<td>European Food Safety Authority</td>
</tr>
<tr>
<td>EN</td>
<td>European Standard</td>
</tr>
<tr>
<td>EG-CPDW</td>
<td>Experts Group on CPDW</td>
</tr>
<tr>
<td>EOTA</td>
<td>European Organisation for Technical Approvals</td>
</tr>
<tr>
<td>EMG</td>
<td>Enhanced Microbial Growth</td>
</tr>
<tr>
<td>ETA</td>
<td>European Technical Approval</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FPC</td>
<td>Factory Production Control</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Name</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>GCMS</td>
<td>Gas Chromatography Mass Spectrometry – (analytical technique for identifying chemicals in leachates)</td>
</tr>
<tr>
<td>GNB</td>
<td>Group of Notified Bodies</td>
</tr>
<tr>
<td>hEN</td>
<td>harmonised European Standard</td>
</tr>
<tr>
<td>ITT</td>
<td>Initial Type Testing</td>
</tr>
<tr>
<td>MS</td>
<td>Member State of the EU</td>
</tr>
<tr>
<td>MTC</td>
<td>Maximum Tolerable Concentration</td>
</tr>
<tr>
<td>NAS</td>
<td>National Acceptance Scheme for construction products in contact with drinking water</td>
</tr>
<tr>
<td>NB</td>
<td>Notified Body (i.e. certification, inspection or testing bodies)</td>
</tr>
<tr>
<td>NCB</td>
<td>Notified Certification Body</td>
</tr>
<tr>
<td>NOAEL</td>
<td>No Observed Adverse Effect Level</td>
</tr>
<tr>
<td>NPD</td>
<td>No Performance Determined</td>
</tr>
<tr>
<td>NTL</td>
<td>Notified Testing Laboratory</td>
</tr>
<tr>
<td>OCL</td>
<td>Oxide Composition List of Vitreous Enamels for European Acceptance Scheme</td>
</tr>
<tr>
<td>PL</td>
<td>Positive List for the European Acceptance Scheme</td>
</tr>
<tr>
<td>RG-CPDW</td>
<td>Regulators Group on CPDW</td>
</tr>
<tr>
<td>RT</td>
<td>Residential Time</td>
</tr>
<tr>
<td>SCC</td>
<td>Standing Committee on Construction (CPD Article 19)</td>
</tr>
<tr>
<td>SCDW</td>
<td>Standing Committee on Drinking Water (DWD Article 12)</td>
</tr>
<tr>
<td>SCHER</td>
<td>Scientific Committee on Health and Environment Risks</td>
</tr>
<tr>
<td>SG1-OM</td>
<td>Experts Subgroup 1 - Organic Materials</td>
</tr>
<tr>
<td>SG2-MM</td>
<td>Experts Subgroup 2 - Metallic Materials</td>
</tr>
<tr>
<td>SG3-NMIM</td>
<td>Experts Subgroup 3 - Non-Metallic Inorganic Materials (including Glassy Materials)</td>
</tr>
<tr>
<td>SG4-AMLP</td>
<td>Experts Subgroup 4 - Assembled Multi-Layers Products</td>
</tr>
<tr>
<td>S/V</td>
<td>Surface vs. Volume Rate</td>
</tr>
<tr>
<td>TC</td>
<td>Technical Committees of CEN</td>
</tr>
<tr>
<td>TDI</td>
<td>Tolerable Daily Intake</td>
</tr>
<tr>
<td>TOC</td>
<td>Total Organic Carbon</td>
</tr>
<tr>
<td>UAP</td>
<td>Unique Acceptance Procedure</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>CAS</td>
<td>Chemical Abstracts Service</td>
</tr>
<tr>
<td>EINECS</td>
<td>European Inventory of Existing Commercial Chemical Substances</td>
</tr>
<tr>
<td>p.p.b.</td>
<td>Parts per billion equivalent to μg/l</td>
</tr>
<tr>
<td>HWT</td>
<td>Hot Water Tank (= Water Heater = Boiler)</td>
</tr>
<tr>
<td>MAC</td>
<td>Maximum Allowed Concentration</td>
</tr>
<tr>
<td>$M_n^T$</td>
<td>Migration Rate at $T^\circ C$ for $n$th period</td>
</tr>
<tr>
<td>HSM</td>
<td>Hot Stage Microscope</td>
</tr>
<tr>
<td>n.a.</td>
<td>not available</td>
</tr>
<tr>
<td>n.r.</td>
<td>not reported</td>
</tr>
</tbody>
</table>
# A FEW USEFUL DEFINITIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitreous Enamel /Porcelain Enamel</strong></td>
<td>Borosilicate glassy structured material, whose chemical composition can be expressed only in term of oxide composition and is almost insoluble in water because all elements are linked mainly with covalent chemical bonds  &lt;br&gt; <strong>V.E./P.E. defined by:</strong>  &lt;br&gt; - EINECS N. 266-047-6;  &lt;br&gt; - CAS N. 65997-18-4.</td>
</tr>
<tr>
<td><strong>Oxide Composition List</strong></td>
<td>List of components/oxides that have been accepted for use in glassy or metallic products (Vitreous Enamels) with respect to toxicological, organoleptic, migration of metals and hygienic characteristics.</td>
</tr>
<tr>
<td><strong>Accepted Without Testing (AWT)</strong></td>
<td>Product or material that is accepted as being fit for use in contact with drinking water due to its composition and other requirements placed on the product/material; obviating the need for testing of the finished product/material  &lt;br&gt; <strong>NOTE:</strong> This concept is applied to cementitious, glassy and metallic materials.</td>
</tr>
<tr>
<td><strong>Accepted Without Further Testing (AWFT)</strong></td>
<td>Product, material or constituent that has been tested and has been shown to be sufficiently below the limits in this EAS to be accepted without further testing.  &lt;br&gt; <strong>NOTE:</strong> See text of EAS for criteria.</td>
</tr>
<tr>
<td><strong>Single Material Product</strong></td>
<td>Product made with one single homogeneous material.  &lt;br&gt; Such products are relatively straightforward to test, using either the product itself, or a representative sample in the case of a large item.</td>
</tr>
<tr>
<td><strong>Assembled Product</strong></td>
<td>These products comprise two or more components, possibly of different materials.  &lt;br&gt; Where the components are of different materials, it may be necessary to separately measure their impacts on water quality. This may require the product to be dismantled, but in some situations it will be proper to test the complete unit in its intended conditions of use.</td>
</tr>
<tr>
<td><strong>Multi-Layers Product (including Coatings)</strong></td>
<td>Product made with more than one layer.  &lt;br&gt; Where there is a foreseeable possibility that the layers not initially intended to be in contact with water may - within the expected life of the product, eventually have an impact on water quality, each layer should be independently tested.  &lt;br&gt; (This situation might arise from migration through layers, or by the long-term deterioration of the layer intended to be in contact). Where such an indirect action is not possible, e.g. because of the existence of a functional barrier (es. V.E.), the layers that will not be in contact need not be tested.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Water Heater / Boiler / Hot Water Tank</td>
<td>Factory made product intended to produce and store hot water in buildings merging the indoor drinking water distribution system. The hot water is produced by means of electricity, gas or fuels and/or indirect exchange hot fluids.</td>
</tr>
<tr>
<td>Substance</td>
<td>Chemical or mixture of related chemicals used to make a material.</td>
</tr>
<tr>
<td>Constituent</td>
<td>Ingredient used to make a material or product.</td>
</tr>
<tr>
<td>Material</td>
<td>Prepared form of a substance, or of a combination of substances, suitable for use in a manufacturing process.</td>
</tr>
<tr>
<td>Material type</td>
<td>Category of materials of similar physical/chemical characteristics (e.g. organic, metallic, vitreous enamels).</td>
</tr>
<tr>
<td>Product</td>
<td>Item made from a material or combination of materials or material types, in the form in which it is placed on the market.</td>
</tr>
</tbody>
</table>

--ooOoo--
ANNOUNCEMENT

JOHN LAMONT

It is with regret that Escol Products Ltd announces the death, in August 2009, of John Lamont at the age of 75 years.

John, who had a background in metallurgy, had a career with the Company which commenced in 1960 and spanned some 35 years up to his retirement in 1995. During that time he acted as Works Director and latterly as Joint Managing Director and, in addition to his works-based role, was active in many industry initiatives.

We send our condolences to his wife, Isobel, and their two daughters Alison and Sheila and their families.

Jim Gray
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