

UKQAA Ash Availability Report 2015



Overview

This document provides an overview of fly ash production and usage from the following coal fired power stations across the UK between 1999 and 2014. There is also some comparative analysis of furnace bottom ash production and usage in recent years.

- Aberthaw
- Cottam
- Drax
- Eggborough
- Ferrybridge
- Fiddlers Ferry
- Longannet
- Ratcliffe on Soar
- Rugeley
- West Burton



Context

Fly ash and furnace bottom ash can be used effectively as alternatives to virgin raw materials in the manufacture of low-carbon, high performance concrete, cement and other construction materials.

Since the 1990s there have been variations in the importance of the different sources of construction materials but the uptake of recycled and secondary materials like fly ash and furnace bottom ash has steadily increased.

Recent years have been challenging for the materials market as a whole due to the significant decline in construction and sales dipping as a result. As the market has begun to recover however, by some 11 per cent between 2012 and 2014, this growth is reflected in demand for fly ash.

In 2014, over three million tonnes of fly ash and 800,000 tonnes of furnace bottom ash were used in the manufacture of construction products and engineering materials. This translates to 70 per cent of the total fly ash produced () and almost 100 per cent of the furnace bottom ash produced. This level of uptake was an industry high, particularly when compared with average demand over the last fifteen years.

The following document tracks the supply and uptake of fly ash since 1999. It explores how a resurging materials market is leading to increased demand for fly ash and furnace bottom ash and how the ash industry is creating new opportunities for an increasingly sustainability focussed construction industry.



Fly ash has a variety of applications including durable concrete blocks for house building

Background

Fly ash and furnace bottom ash are versatile secondary materials that can be used for a variety of beneficial applications in the construction and engineering sectors, from concrete, brick and blocks to engineering fill and land reclamation projects.

An effective pozzolana, or binding material, fly ash can be used in the manufacture of concrete and cement, reducing the amount of traditional materials needed in a cementitious mix. A fine, consistent material, fly ash creates quality, durable products which can resist chloride induced corrosion and chemical attack and minimize risk of early age thermal cracking. Fly ash can also be used successfully as an unbound secondary material, as fill for the construction of embankments for example.

Likewise, furnace bottom ash, which is of a similar composition to fly ash, is used as a lightweight aggregate in the manufacture of building blocks and structural lightweight fill material.

Fly ash and furnace bottom ash also provide significant practical and environmental benefits. The ashes are by products of the combustion process at coal-fired power stations and as such are readily available at locations across the UK. Stored in silos or stockpiled in ash fields, fly ash and furnace bottom ash are also easy to access, excavate and process. This means the ashes are straightforward to recover and resource efficient to manufacture – particularly when compared with virgin raw materials.

The use of fly ash and furnace bottom ash reduces the need to use virgin raw materials and lessens the impact of associated resource intensive processes involved with extracting them. This safeguards finite mineral resources and ensures greater sustainability. Overall, a more resource efficient manufacturing process route is used, with lower embodied carbon and a reduced environmental impact is achieved.



Fly ash was used in the low carbon development of championship golf courses at Celtic Manor

21st century production

Between 1999 and 2014 the UK's coal-fired power stations have produced between four and seven million tonnes of fly ash each year..

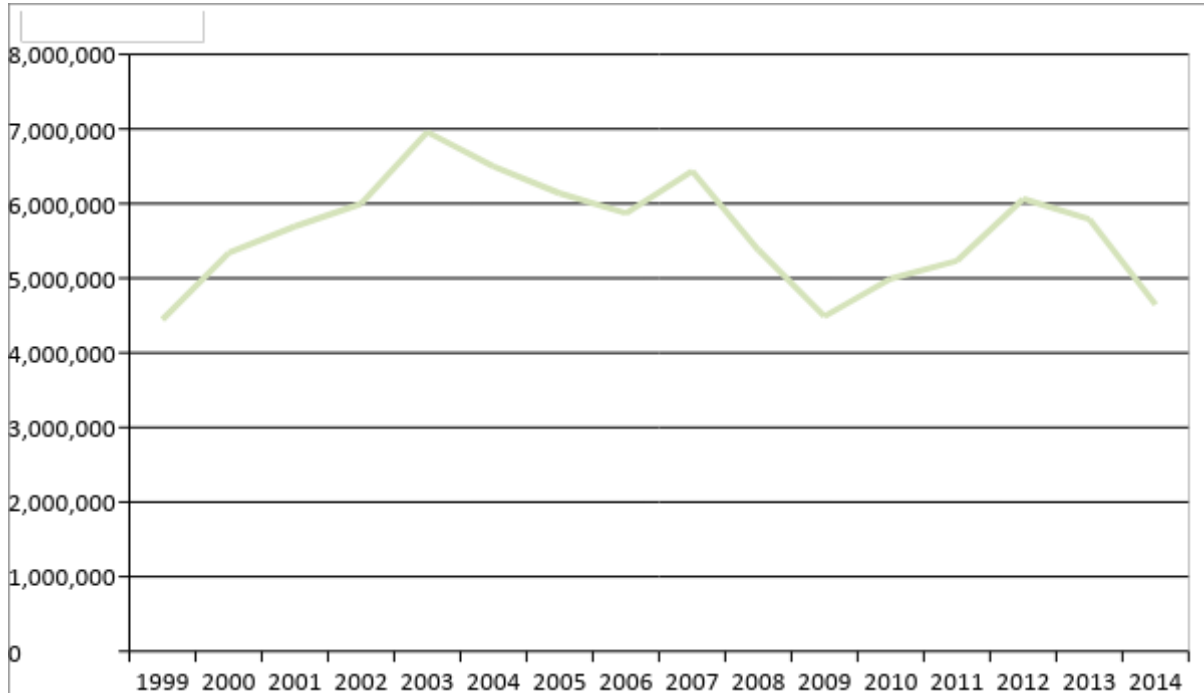


Figure 1: Fly ash production 1999-2014

The production of fly ash is directly linked to the UK's energy mix – increasing when more coal is burnt and levelling off or decreasing when other energy sources take primacy, such as gas.

Since the turn of the century, coal-fired power stations have remained important energy providers and fly ash production has been sustained, averaging over five million tonnes annually. Production peaked at seven million tonnes in the early 2000s as coal-fired power generation was relatively high and remained at over four million tonnes between 1999 and 2014 as reliance on coal power continued.

Ash production rose in the recent post-recession years as the energy market stabilised and coal-fired power retained a central role in the UK's energy mix. As a result the availability and supply of fresh fly ash has remained largely consistent from year to year.

The future of coal

The role of coal fired power stations will change over the next decade and this will have an impact on the production of fly ash and furnace bottom ash. However, with an uncertain gas market and new nuclear and renewables still to be fully realised; coal power remains a central part of the UK's energy mix. In addition, the government's recent Capacity Market Auction has shown that even up to 2021, coal power will play a significant role in energy production in the UK – securing sources of fresh fly ash and furnace bottom ash for some years to come.

21st century usage

Between 1999 and 2014 the construction and engineering sectors have used an increasing proportion of the fly ash and furnace bottom ash produced.

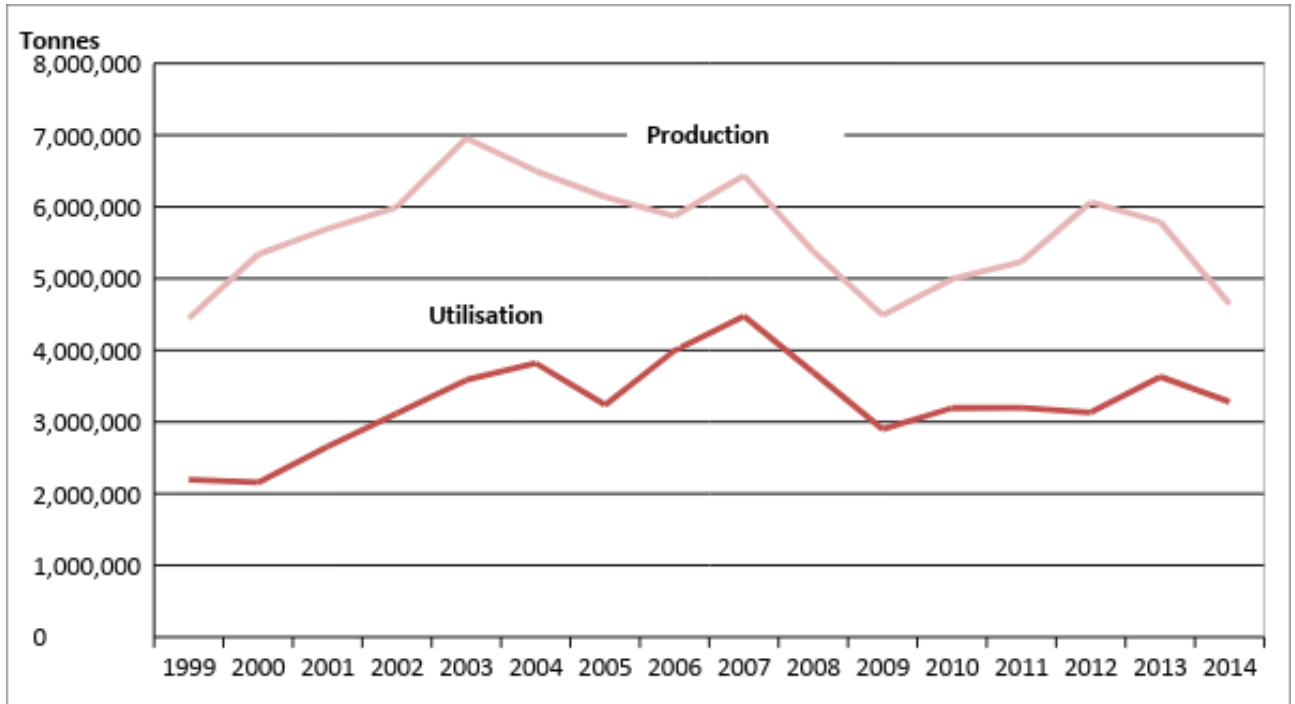


Figure 2: Production versus utilisation for fly ash from 1999-2014

The increased fly ash utilisation from 2005 to 2007 can be attributed to a single mine grouting project which consumed a large amount of by-product over an eighteen month period. In the immediate post-recession period of 2009 to 2012 of the absolute utilisation of fly ash remained relatively level at around three million tonnes, no doubt due to a weak economy and slow growth. However, in 2013 and 2014 with the recovery of the construction and engineering sectors, usage increased beyond three million tonnes.

Since the turn of the century, uptake of fly ash as a percentage of production has increased steadily (Figure 3) Between 1999 and 2007 utilisation rates of over 50 percent of were typical, reaching around 70 per cent in 2007 and again in 2014.

Figure 3: Percentage of fly ash used from 1999 to 2014

Through this period there have been some important shifts in usage. The acceptance of alternative materials has risen since the early 1990s due to increased awareness of the technical, practical and environmental benefits of using fly ash, as well as increasing commercial viability. The ash market suffered in 2005 and between 2008 and 2012 as a result of an uncertain economy and a slowing down in the construction sector, but despite this, more than half of the fly ash produced annually was used for the majority of the period.

As highlighted in Figure 3, 2012-2014 were important years across the minerals and aggregates sector as demand for construction materials increased rapidly and supply shortages in the mining and quarrying sectors drew the construction industry towards the alternative materials market. Architects, engineers and specifiers were redoubling efforts to develop and specify low-carbon, high-performance building materials, and uptake of fly ash increased as a result – despite a sharper dip in overall production, as shown in Figure 2.

Data on fly ash utilisation also shows that despite uptake increasing, a significant amount of surplus fly ash is produced year on year. Typically, some two million tonnes annually are still sent to landfill and therefore opportunities exist for recovery and use of this valuable resource

Last year alone, approximately 141,000 tonnes of fly ash was obtained from temporary stockpiles for use in the construction industry, and this trend for using existing resources alongside fresh ash looks set to continue.

Applications

In recent years, fly ash and furnace bottom ash have been used in a wide variety of applications in the construction products and materials market.

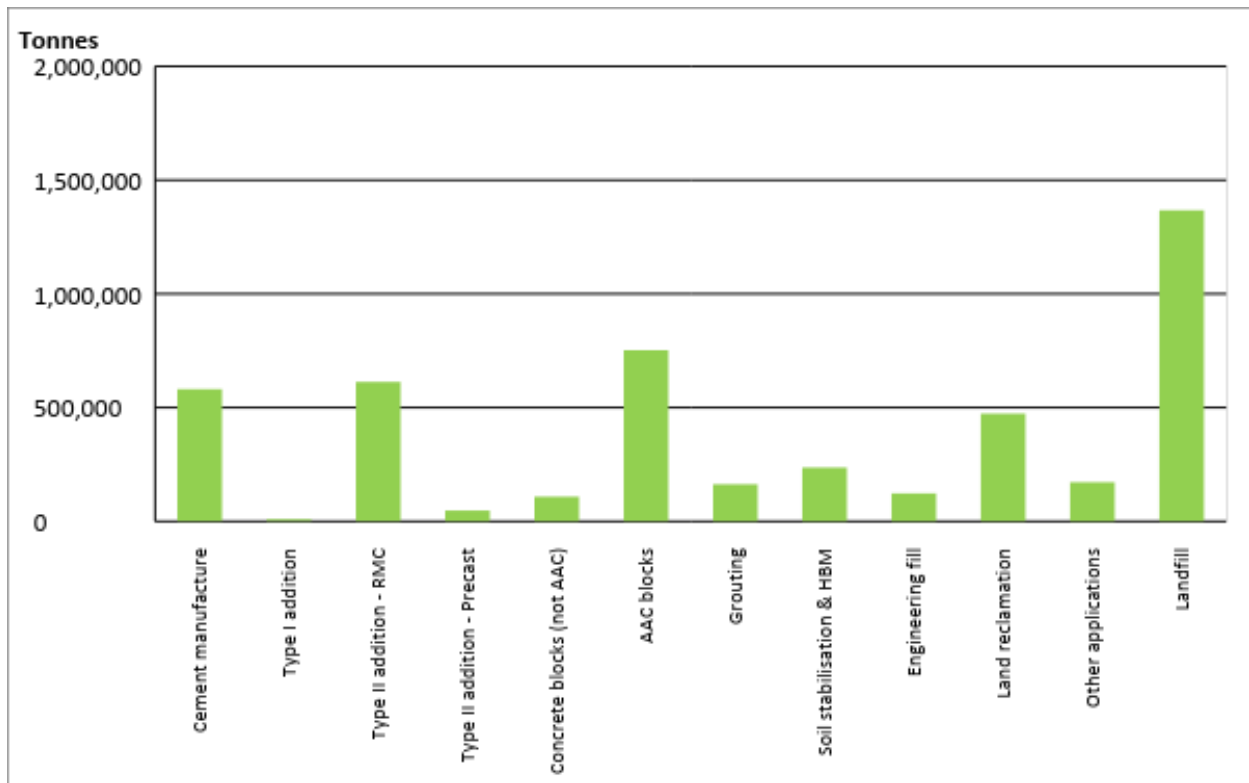


Figure 4: Applications of fly ash in 2014

With an average of over five million tonnes of fly ash being produced annually, the figures also show that, while use of fly ash continues to grow, its applications are increasingly diversified.

During 2014, approximately 70 per cent of the fly ash produced (which equates to over two and a half million tonnes) was used by the construction industry for a variety building products and materials. Uses varied, with 54 percent of fly ash used for bound construction products and materials. Over 12 percent of was used in the manufacture of cement, while 14 and a half per cent was used for Type I&II concrete additions (used in ready-mixed concrete and precast units). Almost 30 per cent was used in conventional concrete blocks, AAC blocks, grouting, soil stabilisation and hydraulically bound materials. In addition to these bound uses, almost three per cent of the total amount of fly ash produced was used for engineering fill and nearly 14 per cent was used for land reclamation and other unbound applications.

Meanwhile, more than 141,000 tonnes of fly ash was also obtained from temporary stockpiles for use mostly in grouting or fill applications,. Almost 100 per cent of the 800,000 tonnes of furnace bottom ash produced was utilised as a lightweight aggregate.

Conclusion

The fly ash production and usage data from 1999 to 2014 and figures on furnace bottom ash highlight important trends in the supply and uptake of fly ash and furnace bottom ash in the 21st century.



Firstly, the production trends show that despite peaks and troughs in demand, there has remained a steady supply of fresh fly ash. This has helped to bolster availability on the materials market overall and support a sustained interest in alternative materials.

Secondly, the usage trends show that the appetite for fly ash as a low carbon, high performance material has remained consistent, despite changes in the energy market and the impact of economic recession on the construction industry. Demand is returning to pre-recession levels and the overall percentage of ash used relative to production is at another record level. This was notable last year, when despite a dip in production, utilisation rates of fly ash continued to climb, while stocks of furnace bottom ash were almost completely utilised.

Thirdly, as confidence in the alternative materials market has grown, manufacturers have also shown there is an increasing preference to use fly ash or furnace bottom ash in a greater variety of products and materials. This versatility of applications and the benefits of fly ash more generally has become widely recognised and in turn has contributed to increased uptake.

These trends underlines two important points: supply of fly ash has remained steady and there is a growing, diverse market for fly ash and furnace bottom ash. This highlights a change in the construction products market and shows the prominence of fly ash and furnace bottom ash, in contributing to sustainable materials market.

Outlook

The fly ash production and usage figures show that the alternative materials market has the capacity to both help stabilise supply in the construction materials market in times of growth and boost product performance. The fly ash being produced is already used successfully –within a range of low carbon, high performance construction products and engineering materials.

The figures also show that at current production levels, there are significant opportunities to source stockpiled ash which has been surplus to demand. With up to 50 million tonnes accumulated across the UK already and increasing yearly, this quantity of unused fly ash could become a sustainable supply. As such it would safeguard availability and help future-proof increasing demand for alternative materials..

Some stockpile supply streams are already developed and operating successfully.. In addition, a UKQAA sponsored research project, investigating transforming stockpile ash into EN 450 ash suitable for structural concrete or cement, is underway at the University of Dundee. – The Innovative Processing Stockpile Ash Project shows how innovation in the applications and uses of fly ash is helping to develop the industry's technical understanding of fly ash and how to maximise the use of available resource. Aside from the production of fresh stocks, which is set to continue for the foreseeable future, ash recovery programmes and research projects highlight a positive outlook for the future supply of fly ash.



For more information about the UKQAA or how you can make use of fly ash or furnace bottom ash, please visit www.ukqaa.org.uk.