

## Conference Paper

# The Influence of Terminology on the Effective Solution of the Coal Ash Handling Problem

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### Abstract

The paper presents the data on a structure of conventional fuels consumption, as well as a structure of fossil fuel consumption at thermal power plants (TPPs) in Russia. The issue of applying the Best Available Technologies (BAT) in Russia is touched upon. Statistics on production and utilization of coal ash in Russia and other countries is given. The paper provides information on the status and terminology of coal ash in different countries. It contains an impact of terminology on the effectiveness of solving the coal ash handling problem in Russia. The paper includes a new legislative definition of coal ash produced at thermal power plants and boiler houses of Russia which meets modern conditions and global trends, as well as requirements for coal energy sector.

**Keywords:** coal ash, coal ash handling, environmental protection legislation

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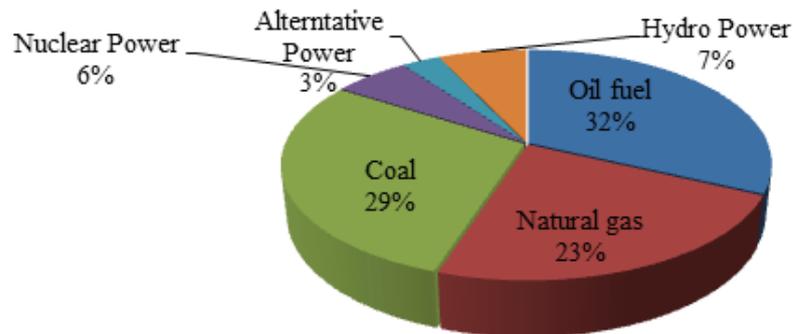
## 1. Introduction

Today the energy needs of the world community are mainly provided by using traditional organic fuel: oil, gas and coal. According to the statistical review of BP for 2015 at current production rates, taking into account the explored oil and gas fields, gas will be enough for about 50 years, and coal - for 114 years. Thus, coal is one of the main resources for the production of heat and electricity at TPPs throughout the world. The proven coal sites are in 70 countries of the world that confirms its availability almost everywhere. The largest coal reserves can be found in North America, Russia, EU countries, China and Australia that is more than 80% of the global coal reserves. Figure 1 shows an analysis of the BP statistical review concerning the structure of world consumption of conventional fuels in 2015.

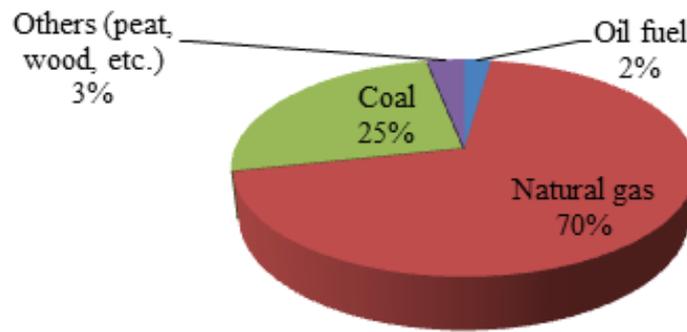
In accordance with the International Energy Agency globally in thermal generation the use of hard coal in the total coal consumption balance makes about 86% and the rest - 14% is brown coal.

Figure 2 presents data on the structure of consumption of fossil fuels at TPPs in Russia. According to the World Wide Coal Combustion Products Network

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**Figure 1:** The structure of world consumption of conventional fuels in 2015.



**Figure 2:** The structure of consumption of fossil fuels at TPPs in Russia.

(www.wgccpn.com), in the energy sector of the world more than 1 billion ton of coal ash is produced annually since 2014. In connection with the increasing trend of coal ash production in accordance with the coal consumption growth by the world energy sector, the issues of effective solution of the coal ash problem are becoming more urgent. Essentially, there are two alternative ways of coal ash handling: their use (beneficial use, recycling) or disposal at ash disposal sites, mostly ash lagoons.

## 2. On the Application of the Best Available Technologies in Russia

Today in Russia, a large-scale development of the regulatory and legal framework for the introduction of the best available technologies in all sectors of the economy and the regulation of the procedure for obtaining comprehensive environmental permits is underway. The Russian Federation has signed a number of international conventions and agreements, according to which it is obliged to reduce both the existing and the potential negative impact of economic activities on the environment, which cannot be achieved without actual implementation of the world-class BAT. A number

of significant changes were made to the Federal Law "On Environmental Protection" (dated 21.07.2014 No. 219-FZ), which came into force on 01.01.2015, with the exception of certain articles that come into force in other periods. In the above-mentioned Federal Law, new concepts and definitions, categories of environmentally hazardous enterprises, requirements for compulsory execution of programs for increasing environmental efficiency are given. It is very important to introduce raising coefficients to the rates of payment for the negative impact on the environment with a view to economic incentive for development and implementation of the measures to reduce the negative impact on the environment and the introduction of BAT. In addition, when calculating fees for negative environmental impact, different coefficients apply to the rates of payment for the disposing the wastes of different classes of hazard.

According to this law, BAT information and technical reference books will be developed for all sectors of the economy, and methodological recommendations for the development of BAT implementation programs will be prepared. In addition to this, RF Government Decree No. 398-r of 19.03.2014 approved a set of measures aimed at refusing to use obsolete and inefficient technologies, switching to the principles of BAT and introducing modern innovative technologies.

Foreign countries have a positive world experience of effective solutions, the use of which would be extremely useful for Russia. The greatest success is achieved in those countries (China, India, Germany, Poland, USA, Greece) which apply BAT throughout the entire cycle of ash handling - from enrichment of energy coals at their production sites and arrangement of efficient coal combustion in boilers to the final use of coal combustion by-products (CCPs) at enterprises of different sectors of the economy.

### 3. World Statistics on Production and Utilization of CCPs

In many developed and developing countries of the world a level of utilization of CPPs, the main of which are fly ash, bottom ash and boiler slag from TPPs, is between 40 and 100% of their annual output. Figs. 3 and 4 show the calculated and estimated data on CCPs production and utilization in various countries in 2010 and 2014, available in the open sources. The first column contains data for 2010, the second – data for 2014. The data regarding the certain country is available at the web sites of National Associations like the American Coal, the Ash Association, the Ash Development Association Australia, the Asian Coal Ash Association etc. For the year 2010 the figures are presented in [1] as well. As for Russia, Figures 3 and 4 contain the expert estimation on CCPs production and utilisation.

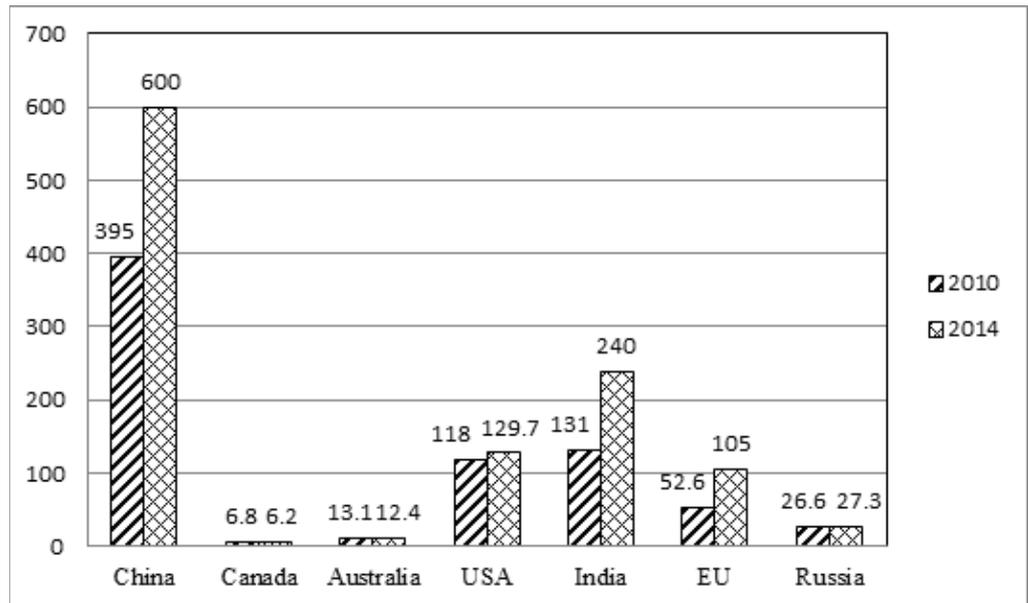


Figure 3: CCPs production in different countries in 2010 and 2014, million tons.

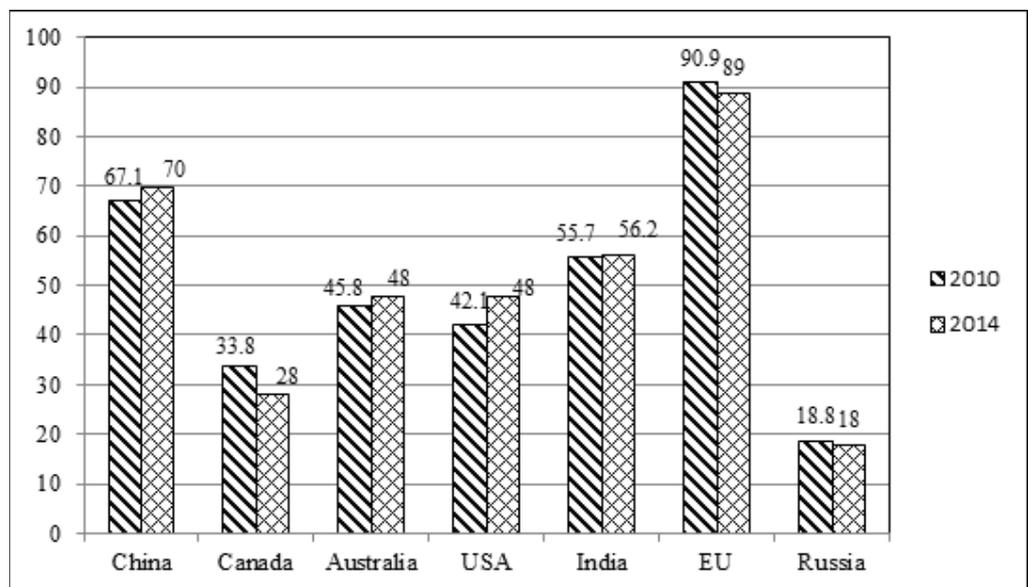


Figure 4: CCPs utilisation in different countries in 2010 and 2014, %.

## 4. Terminology in the Field of CCPs in Different Countries

### 4.1. Are CCPs products or wastes?

One of the technical barriers to increase the level of CCPs beneficial use are technologies of fly ash handling after the ash collecting units and evacuation of bottom ash/boiler slag from the boiler. For high-value low-tonnage, and for large-tonnage applications in various industries, dry uniform materials are needed. Large-tonnage use of ash from hydraulic ash removal systems or ash-and-slag mixture from ash

lagoons without preliminary processing is only possible for road construction, backfilling of the worked mines, reclamation of quarries and levelling the sites for industrial and civil construction. It should be borne in mind the distance from the ash source to the places of its use since at economically inexpedient distances, it will be more profitable to use local natural resources. For other applications, the ash-and-slag mixture or ash from the disposal area should be dried and classified. However, such ash-and-slag will have inferior consumer properties and, accordingly, a lower price than dry ash or slag with original properties. As a result, there is a reduced demand for ash and slag mixture and disposed ash.

According to the Russian legislation coal ashes are wastes that is a legal barrier. In different countries, they are identified under national legislation. In the countries worldwide there is no single legal definition of ash. In this regard, it is not clear: are ashes -wastes from energy generation, either they are coal combustion by-products or recycled materials?

There are different coal ash definitions: Coal Combustion Products, Coal Combustion Residues, Coal Utilisation Byproducts, etc.

In most countries, coal ash has the legal status of waste, but according to the national legislation of some countries, there is a difference between wastes for using and wastes for disposing. As a rule, coal ash is considered to be a non-hazardous waste [1].

## 4.2. Definitions

The members of the Worldwide Coal Combustion Products Network ([www.wwccpn.com](http://www.wwccpn.com)), where Centre for Science and Education "Ecology of Power Engineering" of the Moscow Power Engineering Institute represents Russia, proposed a common terminology for the identification of coal ash, resulting from the separate and co-combustion of coal and other solid fuels of organic origin). The proposed terminology in the field of CCPs handling can be found in the Internet resource at <http://www.wwccpn.com/glossary.htm>.

In order to effectively solve the problem of coal ash handling using the world-class BAT, first of all, it is necessary to adopt a common terminology for all countries for coal ash, generated from combustion of coal or co-combustion of coal with other solid fuel and fix it in National legislation.

It should be noted that the Russian normative document of the electric power industry (RD 34.27.109-96) [2] contains the following coal ash definitions since 1997.

**Fly ash** – particles of mineral residue of solid fuel including a certain amount of unburned carbon (unburned organic part of the fuel), removed by flue gases from the furnace of the boiler.

**Bottom ash/boiler slag** – particles of mineral residue of solid fuel, including a certain amount of unburned carbon, produced in the furnaces of the PFC-boilers, falling out of the flame of flue gas flow in the boiler furnace and evacuated out of the boiler bottom ash/boiler slag extractor with a size up to 40 mm, or coming from the furnace of FBC-boiler through the coolers to the extractors with size up to 10 mm.

**Ash and slag materials** – ash and slag with the initial properties, the mixture of ash and slag and products of their conditioning.

### 4.3. The Proposed Definition for Coal Ash in Russia

In order to increase the level and volume of beneficial use of coal ash, it is necessary to stop thinking of them as wastes. To achieve this, it is proposed to use the following definition of coal ash for legal and regulatory documents at all levels: *“Coal ashes are by-products from combustion of solid organic fuel in boilers, representing valuable mineral raw materials of the man-made origin and being commercial products after certification of their sanitary, hygienic and other consumer properties for their use in various industries. In the case of permanent ash disposal at the ash disposal sites the ashes are referred to as wastes”* [2].

#### 4.3.1. Influence of terminology on effective addressing the coal ash handling problem

If we talk about CCPs handling problem, and primarily about coal ash, for its solution in the current conditions it is necessary, first of all, to change the legal, normative and technical basis in terms of terminology (status and definitions). The significance of the legal definition of coal ash adequate to the modern conditions can not be overstated. Unfortunately, the vast majority of coal ash experts are using the term “Ash and slag wastes”, but not “Ash and slag materials” or “Coal ash”.

According to the authors’ opinion the main point of the coal ash definition is concentrated in one sentence: “Coal ash is a valuable mineral raw material of the man-made origin”. What will be the coal ash as a result of its handling depends on our intentions and actions. If we recycle the ashes, then they will be valuable mineral raw materials of the man-made origin. In this case, we can actually implement BAT not only in the energy sector but in other industries, fulfilling both the requirements of the

RF legislation in terms of environmental protection and rational use of natural mineral resources in other industries by their replacing with coal ash.

Defining coal ash at the legislative level as wastes, we create legal barriers for its beneficial use. In Russia, the main technological barrier to the beneficial use of coal ash is application of hydraulic ash removal systems. Nobody will invest in morally obsolete and economically inexpedient technologies of waste processing and storage. Accordingly, the existing legislative definition of coal ash as a waste will further facilitate their storage at the ash-and-slag disposal sites, stimulating pollution of the environment by coal-fired power plants. What are the best available environmental technologies that can be talked about in this case?

With an annual coal ash production in the countries of the world more than 1 billion ton, it's needed to have huge areas for ash disposals located near large cities. It is well-known that even after application of the necessary complex of nature protection measures, the ash disposals of TPPs have a depressing impact on the environment more or less both in the area of their location, and far beyond their borders. It especially concerns at application of hydraulic ash removal systems.

If the law includes the definition according to which "... coal ash is a commodity product only after certification of its commodity properties," the energy sector will face a choice: what should be done to obtain maximum profit selling coal ash or it should be prepared to pay for increasingly tangible environmental payments, having a constant tendency to increase.

## 5. Conclusion

To effectively solve the coal ash handling problem, the authors consider that one of the top-priority tasks is to do the following:

1. Introduce in legal and regulatory documents of all levels the following definition of coal ash produced from thermal power plants and boiler houses: *Coal ash is a by-product of combustion of solid fossil fuel in boilers, being valuable mineral raw material of the man-made origin and becoming commercial products after certification of its sanitary and other consumer characteristics for use in various industries. In case of permanent ash storage at the ash disposal sites, coal ash is referred to as wastes.*
2. Extend to coal ash, intended for use as commercial products, the influence of entire legal and regulatory documentation relating to the natural mineral resources and non-metallic materials in addition to the legal and regulatory

documents specifically designed for coal ash in so far as it does not conflict with them.

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