Some Considerations regarding the Influence of Coal Quality on the Environment

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Abstract: - Metals together with coal are considered to be the base of the modern industry. Statistics show that together the mineral substances represent almost 20% from global raw material production. They are represented by fuels 12%, metallic ores 6% and nonmetallic minerals 2%. Mining industry is today in a transformation period. Economically, these transformations are impressive if we take into account mineral production variation or mining conditions. Coal is one of the most important fuels for electric power production in the world, but in the same time is the main source of acid rain and global climate warming. For modern society environmental protection is one of the most important problems if we consider the fact that economic development take place in this environment.

Key words: - coal, sulphur dioxide, nitrogen oxide, greenhouse gases, carbon dioxide, climate warming

1 Introduction

Statistics show that mineral substances represent assembly 20 % from ores production which are represented by:

- 12 % fuels,
- 6 % metallic ores,
- 2 % nonmetallics ores.

In the apparent consumption of the most developed countries mineral ores represent 25 % from total ores consumption. Mining industry is now during transformation period. This transformation sums to be impressive, especially if we take into account some essential aspects like:

- quantitative production variation,
- mining products quality,
- mining condition.

The global mineral ores consumption increasing is given by two factors: global population increasing and specific consumption per capita increasing.

In table 1 is shown mineral ores consumption in accordance with world population for period between 1700 and 2000.

Coal is one of the most important fuels for electric power production in the world but in the same time the main source of acid rain and polluting effects associated with global climate warning. Together with gases vapors in air are solid and liquid suspensions. There particles named aerosols and their associated from include dust, smog, steam, fog, vapor, bacteria and other microscopic particles. Atmosphere may “light” with there aerosols oven if particles are numerously. This mechanism breaks down if pollutant particles increase excessively.

Atmospheric air is one of the environments factor that are difficult to be controlled because when pollutants are released in order to be removed. The effect produced by air pollutant gases and particles resulted from coal conduct to public hostility and inter national action. The risks caused by coal cycle may be reduced by performing coal burning technologies and by revere regulations regarding coal industry. These

measures must be increased in condition of economic expansion and social and politic pressure, because now there is not alternative resource to replace coal for power production.
By environmental point of view Romania is in accordance with European organization regulations and apply them gradually. For modern society environmental production is very important because economic development take place this place where we live and take place our activities.

Table 1 Mineral ores consumption in accordance with world population

Period [ani]	Mineral ores consumption			World population		
	Relative Values	Increasing factor	Anual average rate	Relative Values	Increasing factor	Annual average rate
1700	1	0	0	1	0	0
1800	3,5	3,6*	1,25 %	1,28c	1,28*	0
1910	299	8,30*	4,20 %	2,4	1,88*	0
1950	657	2,2*	2,00 %	3,54	1,47*	0,95 %
1963	1239	1,87*	5,00 %	4,56	1,29*	1,85 %
2000	9880	7,25*	5,25 %	9,3	2,04*	1,85 %

Ecological equilibrium is a relative stable relation between different species of animals, plants and microorganisms and their environment were they live. Environmental pollution capable to affect life quality show by more or less important ecological disequilibria.
So, pollution maybe defined like alteration of biotic and abiotic environment, and human goods because of human activities and natural phenomena.
In order to prevent pollution we want know:

- what are the immediate and long term pollution effect,
- how we can prevent and remove pollution,
- what are the costs of de pollution and who support them,
- what level of economical development may be supported by environment without damages.

The assessment of pollution mechanism its effects and implication include a strict interdependence between environmental factors because an action of one of them may provoke influences on other components (with local or long distances effects). Planet protection on long term and ecological equilibrium preservation involve efforts focus on greenhouse gases emissions reducing. Short term strategy provide for a first stage emission stabilization so that in 2005 to have the values from ’90 years.
Ozone layer is placed to 10-15 km from Earth surface and contains 90 % from total atmospheric ozone. Ozone layer protects Earth life because it absorb UV solar radiation on β band (λ 280-390 nm). UV- β radiation is harmful for organism being responsible for skin cancer, cataract, etc.
During 1979-1991 it was observed a reducing of ozone layer with 3 %. In Europe, in some areas this reducing was 7 %. The causes of these phenomena are because of chlorurated compouncls, bromurates compounds and chlorophlorurates hydrocarbons.
Acidification substances emission in the atmosphere, like sulphur dioxide (SO_2) or nitrogen oxides (NO_x), resulted especially by fossil fuel combustion, may persist in air for some days and by this reason transported hundred of kilometers and transformed by chemical inversion into sulphuric acid and nitric acid. This process interferes with ecosystems provoking the well known problem of acidification. Canadian forest damaging,

Scandinavian lakes dead are some concludent examples of the corequence of this phenomena.
In order to limit there emission is recommended to:

- increase the contribution of nuclear energy,
- oil products desulphurisation,
- energy conservation,
- energetically equipments effiency increasing,
- low sulphen coal utilization.

2 Pollutants

The main pollutions resulted by coal combustion are: ash, sulphur oxides, nitrogen oxides, carbon oxides and hydrocarbons, to which is added thermal energy.
When coal is processed for combustion or conservation, are generating effluent and waste also.

2.1. Solid effluents

For each tm of burned or processed coal are generated 40kg to 300kg of ash. In the OECD report it is shown that 150 Mt of ash is dumped annual from industry and power station. Solid waste and dried slussies are generally dumped in reelected ground places, in underground holes or land filling.
The enormous demand for deposit lands and their aspect are an obvious target for adverse reaction of population.
The best option is to use this waste like land filling when materials are tipped pure and simple in the ground holes. This depositing method is however an important polluting sources. During tipping activities results a large amount of dust that reduces the air transparence and pollutes the soil also. Polluted soil may affect the human health through alimentary chain. If there is working scheme of chy depositing like land filling, ash is generally dried in bunkers while in the case of wet depositing ash is dumped in settling ponds or lagoons. In order to prevent leaching in underground water of some toxic elements are necessary the following stages:

- tipping in safe areas,
- compacting,
- rigorous management.

Ash using in industry represent an advantageous alternative by commercial and environmental point of view.

a) Ash

The most part of coal carbon by burning is transformed into heat while inorganic function is transformed into ash. Ash from power stations represent an industrial waste resulted by rapid coal burning at 1200-1600 ^{0}C in the boilers. Depending on coal quality and power station technological characteristics results different ash fractions like:

- furnace slug
- melted ash
- flying ashes by different granulations.

Because the dominant fraction (70-90 %) by this waste is represented by ash it was it was convenient to call this kind of material “ashes”. After burning processes, big fractions that represent 20 % use rattled to the bottom part of the boilers forming furnace slug. Flying ashes are the results of coal burning at lower temperature and most part of them are transported by gaseous effluents and collected in the precipitations.
Because ash removing equipment are not able to retain all solid particles from gaseous effluents, part of this particles are evacuated through stack into the atmosphere like flying ash, and dispersed into the surrounding areas. In the same burning gases contain trace elements in a volatile from and unburned coal.
In Europe regulation for power station are 0.15 mg/m^3 and in Japan the limit is 0.10 mg/m^3.

Depending on ash content coal may be:

1. Coal with moderate ash content when by burning results 10-15 % ash,
2. Coal whit high ash content when by burning results 40-50 % ash and more (Oltenian lignite is included in this category).

Regarding coal type, the most part of world production 62 % resulted by superior coal burning (antracite, hard coal and brown coal) in the time what lignite contribute with just 38 %.

Almost 85 % from total ash is evacuated like flying ash in a dried from, and just 15 % is evacuated like wet ash.
Ash amounts increase every years both in the developed countries and the developing countries.
In USA are produced 90 milion tons in every year. In Germany are produced aproximativley 24 g ash per kW. In Holland were reported 742100 tons of ash, less by 20 times then Romania. It must be mentioned that Holland valorify entire amounts of ash and annual 1300 t of ash satisfy the reuse materials market demands. Romania is of the great ash producers because of national energetically system outshining.

b) Flying ashes

Flying ashes evacuated through burning equipment stack, dust from ash dumps and coal dust from coal deposits, coal transport, and coal processing represent a solid pollutants named aerosols. If these aerosols have a small contents of heavy metals (Cr, Ni, As, they are not toxic.
Toxic aerosols are one of the most novices pollutants. Fortunately, ash contains rarely Pb, F, and As. Toxic aerosols consist of polycyclic aromatic hydrocarbons resulted by incomplete fuel burning. They condensed like very small drapes and maintain in the air. There kind of aerosols is very hazardous because polyciclic hydrocarbons are carcinogenic.

2.2. Gaseous effluents

Gaseous effluents consist of water vapours with small amounts of SO_2, NO_2, HCl and polyciclic aromatic hydrocarbons. Carbon dioxide is released into the atmosphere by coal burning. Since coal became the main source of energy, carbon dioxide concentration increasing became significant. It was anticipated that in 2005 carbon dioxide concentration will increase to 125 % in comparison with 1850. As carbon dioxide imission increase as greenhouse effect will be more evident. Acid gases (SO_x and NO_x) released in the atmosphere form the essential compounds for acid rain appearance.

Sulphur is present in coal like organic and inorganic forms. By burning, the great part of sulphur in converted into SO_2 and just a small part remain in ash like sulphate. A part of SO_2 in oxidated further to SO_3. Nitrogen oxides are produced during coal burning processes by air combustion. Coal nitrogen participate significant to NO_x imission. From nitrogen oxides released into the atmosphere 95 % is represented by nitrogen monoxide (NO) that oxidize immediately into the atmosphere to nitrogen dioxide (NO_2).

a) Sulphur oxides

By combustible sulphur oxidation, the most part (over 95 %) transform into SO_2. Conversion of SO_2 to SO_3 take place both in the flame in oxygen large exces and in the gases transect in the presence of vanadium oxides and even of iron oxides that take the role of catalyst especially at temperatures over 800 ^{0}C.

Released in the atmosphere, sulphur dioxide (SO_2) react in small proportion (1-2 %) with oxygen, under ultraviolete solar radiation action forming sulphuric anhidride (SO_3) as equation:

$$2SO_2 + O_2 \xrightarrow{uvr} 2SO_3$$

Sulphuric anhidride (SO_3) react with atmospheric water vapours and form sulphuric acid (H_2SO_4). During fogy period and in very wet period conversion rate may achieve 15,7 %.

$$SO_3 + H_2O \rightarrow H_2SO_4$$

Observations. H_2SO_4 amount from atmosphere is greater than can justify by primary SO_3 emission. It is possible to exist other H_2SO_4 producind mechanisms. It is that SO_2 is converted quickly to SO_3 and sulphates but the transformation is not very clear. SO_2 presence into the atmosphere is the main reason of plants damaging. Plants sensitivity to SO_2 depend on concentration and exposing type. Damages caused by SO_2 and chlorophile assimilation reducing photosynthesis.

b) Nitrogen oxides

By environmental protection point of view, from nitrogen oxides are important nitrogen (NO) and

nitrogen dioxide (NO_2).Nitrogen monoxide (NO) released into the atmosphere, in the presence of air oxygen and ultraviolete action are rapidly transformed into NO_2, that is very toxic.

$$2NO + O_2 \rightarrow 2\ NO_2$$

Observations.

- Oxidation kinetics studies shows that besides above reaction a small amount of nitrous anhydrite are formed, most of it dissociated:

$$NO + NO_2 \rightarrow\ N_2O_3$$

- IR spectrum show that nitric anhydrite (N_2O_5) is formed also, but it disappeared suddenly by other reactions:

$$NO_2 + O_2 + NO \rightarrow\ NO_2 + NO_3^{\cdot}$$

$$NO_3 + NO_2 \rightarrow\ N_2O_5$$

$$N_2O_5 + NO \rightarrow\ 3NO_2$$

While NO formation and formation equilibra are promoted by high temperatures, oxidation to NO_2 is an exotherm reaction promoted by low temperatures. Nitrogen protoxide (N_2O) is recently taken into account. Even if nocive effects are wellhnown there is no any country that promulgate regulations regarding N_2O emission for environmental protection. Nitrogen protoxide (N_2O) is a stable gas that decomposes at 600 ^{0}C into the elements, respectively N_2 and O_2. N_2O in the limit layer has a inert gas behavior. Experimmentaly was proved that primary and recondary NO_x removing measures from burning gases are accompanied by undesirable emissions, almost every time, like CO, N_2O, NH_3.

Noxious effect of N_2O is double. First, there is the greenhouse effect of N_2O because N_2O spectrum at 16-18 μm is superpored over CO_2 absobtion spectrum. Generaly, N_2O contribution at global atmosphere warming is approximately 4 %. Secundary and the most noxious effect is the N_2O contribution at ozone layer reducing from stratosphere (10-15 km high). The most important catalyst that contribute to ozonelayer destruction is NO* radical, resulted by nitrogen protoxide (N_2O) decomposition.

c) Carbon dioxide (CO_2)

Carbon dioxide is toxic just at high concentrations (over 5000 ppm). Carbon dioxide influences climate through greenhouse effect, and it is contribution to the global climate warning approximatively 50 %.

Till now there are not technological solution to remove CO_2 emissions. The only one fezable solution to reduce emissions are the increasing of thermal energy producing, transformation and utilization or other sources utilization like nuclear power or nonconventional energy.

Now the CO_2 emission trend to stabile to ’90 years level.

Fortunately, CO_2 is removed from atmosphere by chlorophilian assimilation (photosynthesis)

$$6CO_2 + 6H_2O \xrightarrow{h\gamma} C_6H_nO_6 + 6O_2$$

By it is effect this reaction may be called life equation.

3 Conclusions

- Environmental pollution became a social and economic problem especially in developed countries.

- Pollution grow such as were imposed legislative measures to limit the damaging effects.

- These measures must be harden even in economical expansion and political and social pressure conditions.

- Planet protection on long term and ecological equilibrium preservation support to focus the effort in order to reduce greenhouse gases emission.

- By Environmental Protection Law 137/1995 in our country laid the foundations of environmental impact assessment procedures.

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