Absatzmarkt ist China mit ungefähr 25 % des Weltmarktvolumens, gefolgt von den USA, Japan und Deutschland. In reifen Märkten wie Europa oder den USA spielen Betriebskosten und energetischer Wirkungsgrad für die Absatzchancen eines Produktes eine große Rolle, während in jüngeren Märkten wie China verstärkt über den Preis verkauft wird.[2][3]

China ist auch der größte Transformatorproduzent der Welt: 90 % der dort verkauften Transformatoren werden in diesem Land gebaut, die meisten davon von ausländischen Gesellschaften. Die weltweit führenden Hersteller von Transformatoren sind ABB und Alstom. Weitere große europäische Hersteller sind Areva, Siemens und die 2005 von Siemens übernommene VA Technologie. Die führenden Anbieter der USA sind Cooper Industries, General Electric [2], [3].

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COAL-WATER SLURRY

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The coal-water slurry (CWS) is non-Newtonian fluid, which has great potential for development as a fuel for direct burning in the furnace of a boiler or gasification. The coal-water slurry is a relatively new technology. Therefore, there are many different methods for its preparation. This paper focuses on the characteristic of this technology and shows the technologies of CWS transportation and storage.

Main characteristics of CWS are divided into two groups: ones, which concern fluidity (rheological characteristics, sedimentation) and ones, which relate to burning (full burning of the organic compounds, energy potential) [1].

CWS is a slurry mixture, where very fine coal particles are dispersed in water, exhibiting non-Newtonian fluid properties. Consequently, its fluidity characteristics are very important to evaluate the ways of its transportation and working conditions.

Technologies of transportation and storage of CWS can be classified as follows:

1. Transport via pipelines

2. Transport by sea
3. Storage in the tank

The most important factor in the process of transportation and storage is to prevent deposition (formation of dense deposit), which can cause problems. Currently, anionic additives are widely used, but they are generally ineffective. Thus, there is a need to develop technologies to prevent precipitation.CWScontains coal particles of different diameters. Predominant by number are carbon particles of a size of about 1 micron. It is necessary to limit the content of fine particles to a certain extent to prevent precipitation. If there is no deposition process in CWS, it is called stable and additives for its preparation are called stabilizers. It is known that there are additives that can provide effective stabilization, but the mechanism of formation of the interparticle structures remains unsolved.

There are four different methods of stabilization:

- by increasing the molecular weight of anionic dispersants;
- using synthetic polymeric polysaccharide;
- with the use of natural polysaccharide;
- with the use of inorganic minerals.

Stabilization by increasing the molecular weight of anionic dispersants.

Research has shown that increasing the molecular weight of dispersants improves static stabilization.Poly(metha)acrylic, polystyrene sulfuric acid can be used as dispersants.

Stabilization using synthetic polymeric polysaccharide.

According to studies, the use of carboxymethylcellulose allows stabilization and reduces the volume of xanthan rubber and mineral substances.

Stabilization with the use of natural polysaccharide.

Two polysaccharides were assessed: Kelzan-D [2] and S-194 [3]. The viscosity of the mixture with S-194 is lower, than with Kelzan-D. Also, necessary volume is less for S-194 – 0.1% of the mass of mixture (0.3% for Kelzan-D). Consequently, S-194 is a perspective stabilizer, both in economics and effectiveness terms.

Stabilization with the use of inorganic minerals.

Inorganic minerals are widely used along with the above stabilizers (e.g., attapulgite). Studies have shown that even the use of inexpensive minerals provides sufficient stabilizing effect. Inorganic minerals easily undergo flocculation, because they consist of smaller particles. Thus,it is possible to form flocculation structure, which is capable of preventing the deposition of carbon particles.

Previously, the stationary stability test was used to evaluate stability of CWS. The mixture was placed in a container for a certain period of time (from one week to several months). Then, the thickness of the sediment layer was measured with the indentation of a rod [4, 5].

Usui(Japanese scientist)designed a device to test stability of CWS [6].

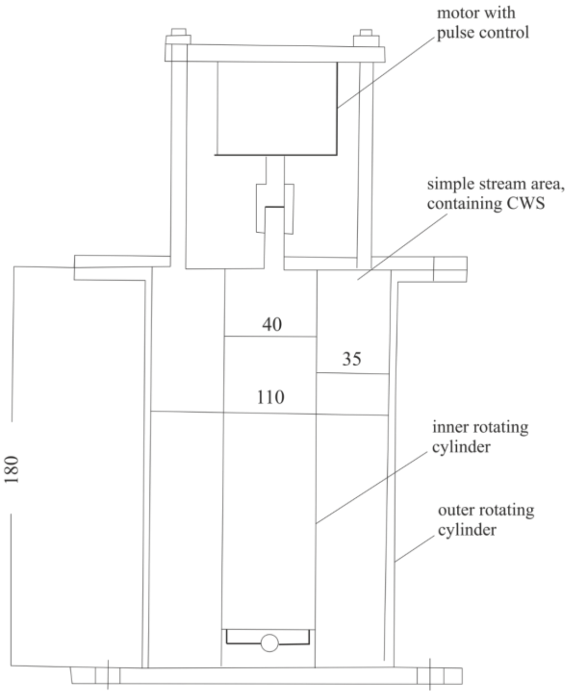

Fig. 1 – Equipment for stability test

The main processes of CWS production technology are the selection of raw coal, appropriate additives, grinding coal to the desired particle size and stirring.

An important factor, defining the technology of production of CWS is characteristic of coal. They may be different depending on the type of coal, and often vary quite strongly, even when using coal of the same brand. It is assumed, that the change of coal's type and some conditions, such as mixing, can be a key factor.

Therefore, in order to establish a stable production of high quality CWS at a low price the production process must be reliable. Also, it is required to monitor and control characteristics.

The main factors are:

- The high concentration of coal (the main factor affecting the economy of the entire process of production and combustion of coal-water slurry)
- Regulation of the particle size distribution (the main condition for obtaining a high concentration of coal)
- Ease of monitoring the characteristics (stabilization of all the characteristics to avoid defective products)
- The possibility of mass production (increased productivity, the possibility of high-volume production at high quality)
- Cost-effectiveness (the basis of any commercial prospects)
- Safety and environmental feasibility

There are different methods of production of CWS. Each method should be assessed from economic point of view and the most suitable is to be chosen.

Single-stage wet grinding system.

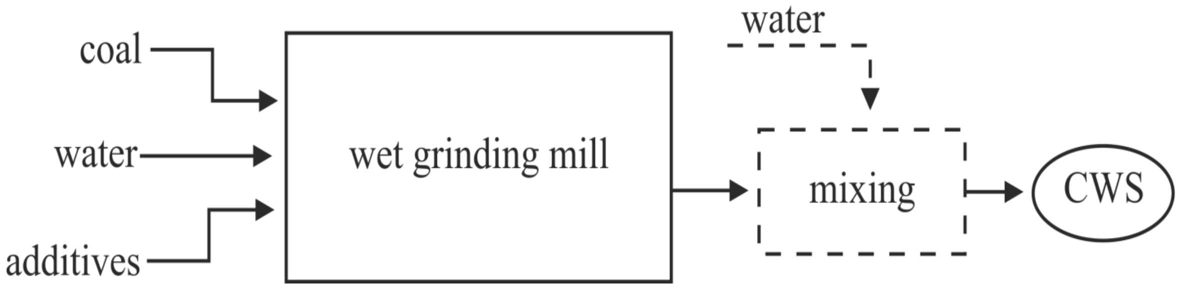

Fig. 2 – Single-stage wet grinding system

Consistent two-stage wet grinding system with double feed of coal

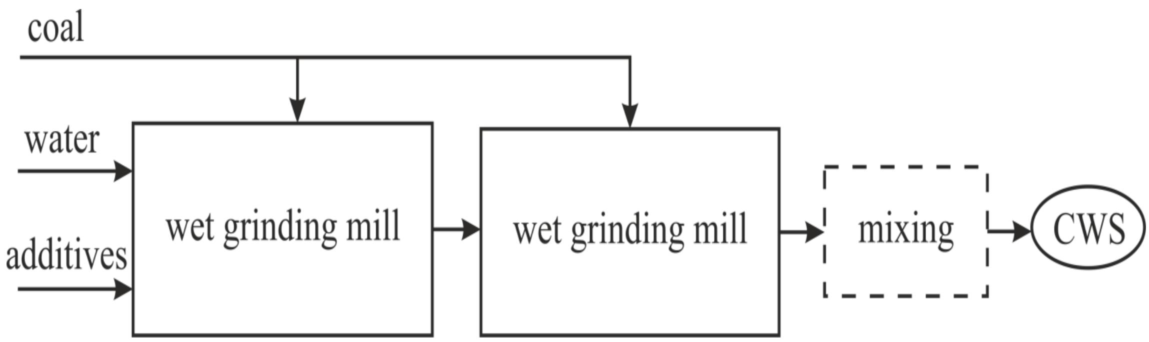

Fig. 3 – Consistent two-stage wet grinding system with double feed of coal

Combined two-stage wet grinding system with secondary processing of coal

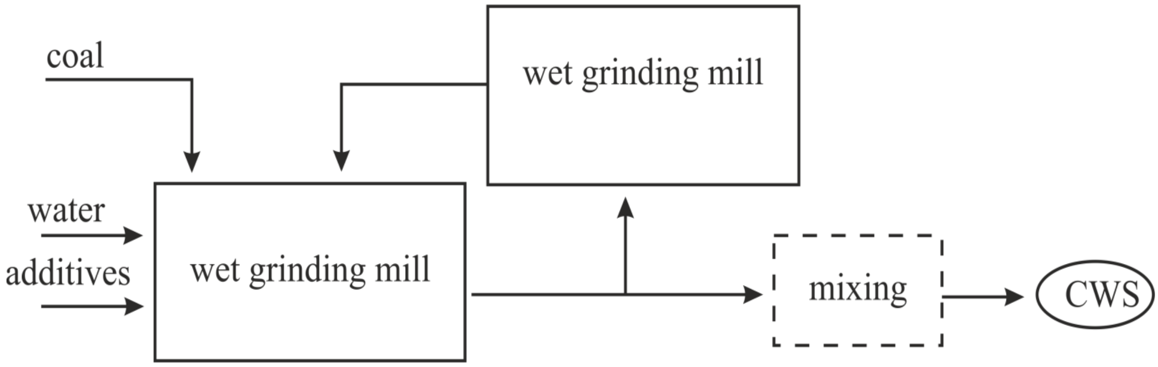

Fig. 4 - Combined two-stage wet grinding system with secondary processing of coal

CWS properties resemble the properties of fuel oil, except that CWS has a low calorific value and high viscosity. Burning of CWF (coal-water fuel) is usually carried using a sputtering method. Thus, the concentration of coal, particle size and viscosity are the most important factors for combustion.

Table 1
CWS characteristics

Characteristics	Units	CWS	Fuel oil
Solid particles	-	Coal	-
Fluid	-	Water	Fuel oil
Concentration of solid particles	%	75	-
Absolute viscosity	$(mPa*s)^{-1}$	500-1500	80-800
Specific weight	-	1.2-1.3	0.8-0.95
Calorific value	kcal/kg	17000-21000	43000-46000
Ash content	%	5-10	<0.1

Concentration of coal

The higher concentration of coal, the less the moisture content, causing a reduction in energy losses expended in the evaporation of moisture. Therefore, it is necessary to seek to increase the concentration of coal to improve the economic feasibility. However, with the increasing concentration of coal greatly increases the viscosity of CWS.

The rapid increase of viscosity can make spraying CWS very complicate. Therefore, it is decided to limit the concentration of coal in CWS to 60-75%.

Size of solid particles

It is necessary, that the slurry fuel has a wide range of particle size distribution to improve the concentration of solid particles.

Table 2
The impact of the size of coal particles

Size of solid particles (microns)	Category	Effect	Ways to prevent effect
>150	Coarse	the main reason for the unburned carbon in the ash	removal of coarse coal particles by sieving
150-10	Fine	basiccomponent for combustion (60-80%)	selection of the optimum grinding system
10-1	Very fine	help to create CWS with a high concentration of coal	selection of the most suitable additives for optimization of the particles
<1	Ultra fine	increase the fluidity and stability of CWS, but the excessive amount prevents the formation of CWS with high concentration	selection of an appropriate system of ash removal

Viscosity

In contrast to the fuel used in boilers earlier, CWS has sharply apparent viscosity. Moreover, the suspension is subject to change over time. As a result, it is preferable that new fuel has pseudo-plastic and thixotropic properties. Typically, the aim in the preparation of CWS is to get a viscosity of about 1000 Pa*s.

Conclusion

To sum up, coal-water fuel got an impulse for the development as alternative to fuel oil due to the oil crisis in 1973. The process of development took place in many countries and the usefulness of CWS has been proven. However, in 1986 there was a reverse oil crisis. Oil prices have shifted to the mark "low and stable." This is a serious factor, which prevents the formation of a market for CWF.

According to UN statistics, 70% of fossil fuel in the world is coal.This means that the role assigned to coal, is very important. In this regard, if the water-coal fuel can be implemented as high-quality water-coal slurry with low ash and sulfur content, there is no doubt that it takes its place as the power source to minimize the negative impact on the environment, thereby displacing oil in the next century.

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HYBRID ELECTRIC VEHICLE

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«A hybrid electric vehicle (HEV) is hybrid of gasoline and electric vehicle which combines a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system (hybrid vehicle drivetrain)» [1]. Hybrid electric vehicles are powered by an internal combustion engine or other propulsion source that can be run on conventional or alternative fuel and an electric motor that uses energy stored in a battery. HEVs combine the benefits of high fuel economy and low emissions with the power and range of conventional vehicles.

HEVs are classified onparallel, series and mild(full) hybrids:

The parallel hybrid uses both engines an internal combustion and electric engine. In the parallel hybrid, the conventional and electric engines are attached to one transmission, which allows both of them to power the car at the same time. The fuel