PRODUCTS AND BY-PRODUCTS OF COAL pdf

1: Coal Combustion Wastes

Thousands of products are made with coal or coal by-products, including aspirins, soap, dyes, solvents, plastics, and fibers such as rayon or nylon. Coal is an important ingredient in production of products that require activated carbon, carbon fiber or silicon metal.

It has many applications such as producing heat for households, firing industrial generators, manufacturing cast iron , etc. It can also be produced in the industry to obtain products like coke, tar and coal gas. These by-products are beneficial to us too. Coke is a high-carbon product obtained by the destructive distillation of coal. The amount of carbon content in coke is so high that it is said to be an almost-pure form of carbon. Coke is grayish-black in colour and is a hard, porous solid. The most common use of coke is as a fuel for stoves, furnaces and blacksmithing. It is sometimes preferred over coal because burning coke produces very little smoke. It is also used to produce iron in a blast furnace. Coke is used to manufacture steel and many other materials. It is obtained as a byproduct in the process of making coke. Though its colour is the same as coke, tar is a highly viscous liquid. It also has an extremely unpleasant smell. Coal tar is widely used to manufacture paints, perfumes, synthetic dyes, photographic material, drugs and explosives. It can be utilized to make insecticides and pesticides. Naphthalene balls that are commonly used to keep moths away are made from tar. Coal tar is an ingredient of anti-dandruff and lice-repelling shampoos, soaps and ointments. This is also obtained as a byproduct while producing coke, and again, just like tar, its smell is not very pleasant. It is a highly flammable gas as the main component of it is methane. Thus, if not regulated carefully, it can form mixture with air resulting in explosions. It is mainly used as a fuel in industries situated near coal processing plants. Earlier, it was used as a source of light. In the year , it was used in London for the first time as street lighting. Now, it is more commonly used to provide heat for domestic and industrial purposes. Practise This Question Heating of coal in the absence of air is known as:

2: Coal waste - SourceWatch

Coal combustion products are expected to continue to play a major role in the concrete market. Their use in other building products is also expected to grow as sustainable construction becomes more prominent, and more architects and building owners understand the benefits of using CCPs.

Electricity Generation and By-products Electricity Generation and By-products The chemical energy stored in coal is released when it is burned and changed to thermal heat energy that is used to produce steam. The steam turns a turbine, and that mechanical energy is used to turn a generator to produce electricity. Steps in Electricity Generation from Lignite Lignite is delivered to the power plant. The crushed or pulverized coal is then blown into a boiler combustion chamber, or furnace. Pipes inside the boiler carry water, which is turned to steam by the extreme heat of the combustion. The steam is injected at high pressure into a turbine. The steam reaches pressures up to 3, pounds per square inch psi. The high-pressure steam causes the turbine blades to spin, turning a drive shaft. The drive shaft is connected to a generator, where magnets spin within wire coils to produce electricity. The exhaust steam from the turbine is drawn into a condenser, which changes the steam back to its liquid state. The steam water is then returned to the boiler to repeat the cycle. Burning coal results in the production of bottom ash, fly ash, and various gases. The ash is captured and converted into useful by-products; the gases are "scrubbed" and then released through the emission stacks. Bottom ash is the large ash material that is removed from the bottom of the furnace. Its uses include aggregates in road bases, pavement, and as a product for sanding icy winter roads. Fly ash consists of particles that are removed from the exhaust. It is recycled and used for construction and other commercial purposes. Fly ash got its name because it could fly out from the power plant if it were not captured. Fly ash added to concrete results in a concrete that is easier to work with, stronger, lasts longer, and is of higher quality than concrete made with Portland cement. Some ready-mix concrete producers are replacing more than 30 percent of their cement with fly ash. It is used in the construction business for roads, bridges, sidewalks, curbs, foundations, commercial buildings, and homes. Other products enhanced by fly ash include carpet, paint, insulation, ceiling and flooring tiles, lumber, bricks, and shingles. Fly ash is also used to strengthen soil and as a soil stabilizer to prevent soil erosion. The stack on a power plant acts like a chimney and allows exhaust to leave the plant. The visible plume that comes out of the stack at a coal-based power plant, particularly in winter, is almost all water vapor. Antelope Valley Station near Beulah: North Dakota is one of only seven states to meet all air quality standards set by the federal United States government as of Photo courtesy of Basin Electric Power Cooperative Emissions Control Technology is used to remove pollutants from the exhaust before it is released into the air. Two types of particulate control devices for particulate matter are the baghouse and the precipitator. A baghouse is a giant filter that removes particles from plant exhaust. An electrostatic precipitator uses the attraction of positive and negative electrical particles to trap particles in the flue gas. Flyash trapped by the baghouse or electrostatic precipator is recycled and used for construction and other commercial purposes. Scrubbers are used to remove SOx or sulfur-based emissions. This is done with a chemical process. The flue gas mixes with a spray of water and a chemical usually lime to let the gasses combine with the spray to be removed. NOx occurs in nature with events such as lightning strikes and forest fires. NOx occurs in a boiler, car or furnace due to high temperature and the presence of Nitrogen and Oxygen. According to the US Environmental Protection Agency EPA , 50 percent of NOx emissions are from automobiles and other mobile sources, 20 percent from electric power plants, and 30 percent from a variety of other sources such as industrial furnaces and manufacturing of materials.

3: Coal gasification - Wikipedia

These by-products are beneficial to us too. Coke: Coke is a high-carbon product obtained by the destructive distillation of coal. The amount of carbon content in coke is so high that it is said to be an almost-pure form of carbon.

History[edit] In the past, coal was converted to make coal gas, which was piped to customers to burn for illumination, heating, and cooking. High prices of oil and natural gas are leading to increased interest in "BTU Conversion" technologies such as gasification , methanation and liquefaction. The Synthetic Fuels Corporation was a U. The corporation was discontinued in Early history of coal gas production by carbonization[edit] This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. The latter called it "Spirit of the Coal". William Murdoch later known as Murdock discovered new ways of making, purifying and storing gas. Among others, he illuminated his house at Redruth and his cottage at Soho, Birmingham in , the entrance to the Manchester Police Commissioners premises in , the exterior of the factory of Boulton and Watt in Birmingham , and a large cotton mill in Salford , Lancashire in In France, Philippe le Bon patented a gas fire in and demonstrated street lighting in In , Rembrandt Peale and four others established the Gas Light Company of Baltimore , the first manufactured gas company in America. In , natural gas was being used commercially in Fredonia, New York. The first German gas works was built in Hannover in and by there were gas works in Germany making town gas from coal, wood, peat and other materials. The foreman told me that stokers were selected from among the strongest, but that nevertheless they all became consumptive after seven or eight years of toil and died of pulmonary consumption. That explained the sadness and apathy in the faces and every movement of the hapless men. The credit for this goes to the inventor and entrepreneur Fredrick Winsor and the plumber Thomas Sugg , who made and laid the pipes. Digging up streets to lay pipes required legislation and this delayed the development of street lighting and gas for domestic use. Meanwhile, William Murdoch and his pupil Samuel Clegg were installing gas lighting in factories and work places, encountering no such impediments. Early history of coal gas production by gasification[edit] This section does not cite any sources. August Learn how and when to remove this template message In the s every small to medium-sized town and city had a gas plant to provide for street lighting. Subscribing customers could also have piped lines to their houses. By this era, gas lighting became accepted. Gaslight trickled down to the middle class and later came gas cookers and stoves. In the s, processes for making Producer gas and Water gas from coke were developed. Unenriched water gas may be described as Blue water gas BWG. Mond gas , developed in the s by Ludwig Mond , was producer gas made from coal instead of coke. It contained ammonia and coal tar and was processed to recover these valuable compounds. Blue water gas BWG burns with a non-luminous flame which makes it unsuitable for lighting purposes. It has a higher calorific value and burns with a luminous flame. The carburetted water gas process was improved by Thaddeus S. CWG was the dominant technology in the USA from the s until the s, replacing coal gasification. Development of the coal gas industry in the UK[edit] This section does not cite any sources. August Learn how and when to remove this template message The advent of incandescent gas lighting in factories, homes and in the streets, replacing oil lamps and candles with steady clear light, almost matching daylight in its colour, turned night into day for manyâ€”making night shift work possible in industries where light was all importantâ€"in spinning , weaving and making up garments etc. The social significance of this change is difficult for generations brought up with lighting after dark available at the touch of a switch to appreciate. Not only was industrial production accelerated, but streets were made safe, social intercourse facilitated and reading and writing made more widespread. Gas works were built in almost every town, main streets were brightly illuminated and gas was piped in the streets to the majority of urban households. The invention of the gas meter and the pre-payment meter in the late s played an important role in selling town gas to domestic and commercial customers. Universities were slow to respond to the needs of the industry and it was not until that the first Professorship of Coal Gas and Fuel Industries was founded at the University of Leeds. Later it included a centre for training apprentices but its major contribution to the industry was its gas appliance testing facilities, which were made available to the whole industry, including gas appliance manufacturers. Much coal for the gas works was shipped by sea and was vulnerable to enemy attack. The gas industry was a large employer of clerks, mainly male before the war. But the advent of the typewriter and the female typist made another important social change that was, unlike the employment of women in war-time industry, to have long-lasting effects. The inter-war years were marked by the development of the continuous vertical retort which replaced many of the batch fed horizontal retorts. Benzole as a vehicle fuel and coal tar as the main feedstock for the emerging organic chemical industry provided the gas industry with substantial revenues. Petroleum supplanted coal tar as the primary feedstock of the organic chemical industry after World War II and the loss of this market contributed to the economic problems of the gas industry after the war. A wide variety of appliances and uses for gas developed over the years. Gas fires , gas cookers , refrigerators , washing machines , hand irons , pokers for lighting coal fires, gas-heated baths , remotely controlled clusters of gas lights , gas engines of various types and, in later years, gas warm air and hot water central heating and air conditioning , all of which made immense contributions to the improvement of the quality of life in cities and towns worldwide. The evolution of electric lighting made available from public supply extinguished the gas light, except where colour matching was practised as in haberdashery shops. This section does not cite any sources. August Learn how and when to remove this template message Scheme of a Lurgi gasifier During gasification, the coal is blown through with oxygen and steam water vapor while also being heated and in some cases pressurized. If the coal is heated by external heat sources the process is called "allothermal", while "autothermal" process assumes heating of the coal via exothermal chemical reactions occurring inside the gasifier itself. It is essential that the oxidizer supplied is insufficient for complete oxidizing combustion of the fuel. During the reactions mentioned, oxygen and water molecules oxidize the coal and produce a gaseous mixture of carbon dioxide CO_2 , carbon monoxide CO , water vapour H_2O , and molecular hydrogen H_2. Some by-products like tar, phenols, etc. This process has been conducted in-situ within natural coal seams referred to as underground coal gasification and in coal refineries. The desired end product is usually syngas i. If, however, hydrogen is the desired end-product, the coal gas primarily the CO product undergoes the water gas shift reaction where more hydrogen is produced by additional reaction with water vapor: For low-grade coals i. As well, some coal gasification technologies do not require high pressures. Some utilize pulverized coal as fuel while others work with relatively large fractions of coal. Gasification technologies also vary in the way the blowing is supplied. In this case the oxidizer passes through coke and more likely ashes to the reaction zone where it interacts with coal. The hot gas produced then passes fresh fuel and heats it while absorbing some products of thermal destruction of the fuel, such as tars and phenols. Thus, the gas requires significant refining before being used in the Fischer-Tropsch reaction. Products of the refinement are highly toxic and require special facilities for their utilization. As a result, the plant utilizing the described technologies has to be very large to be economically efficient. It was built due to embargo applied to the country preventing it from importing oil and natural gas. RSA is rich in Bituminous coal and Anthracite and was able to arrange the use of the well known high pressure "Lurgi" gasification process developed in Germany in the first half of 20th century. In this case there is no chemical interaction between coal and oxidizer before the reaction zone. The gas produced in the reaction zone passes solid products of gasification coke and ashes , and CO_2 and H_2O contained in the gas are additionally chemically restored to CO and H_2. As compared to the "direct blowing" technology, no toxic by-products are present in the gas: The reason for reviving the interest to this type of gasification process is that it is ecologically clean and able to produce two types of useful products simultaneously or separately: The former may be used as a fuel for gas boilers and diesel-generators or as syngas for producing gasoline, etc. Combustion of the product gas in gas boilers is ecologically cleaner than combustion of initial coal. Thus, a plant utilizing gasification technology with the "reversed blowing" is able to produce two valuable products of which one has relatively zero production cost since the latter is covered by competitive market price of the other. Industrial plants utilizing it are now known to function in Ulaan-Baatar Mongolia and Krasnoyarsk Russia. Pressurized airflow bed gasification technology created through the joint development between Wison Group and Shell Hybrid. Hybrid is an advanced pulverized coal gasification technology, this technology combined with the existing advantages of Shell SCGP waste heat boiler, includes more than just a conveying system, pulverized coal pressurized gasification burner arrangement, lateral jet burner membrane type water wall, and the intermittent discharge has been fully validated in the existing SCGP plant such as mature and reliable technology, at the same time, it removed the existing process complications and in the syngas cooler waste pan and [fly ash] filters which easily failed, and combined the current existing gasification technology that is widely used in synthetic gas quench process. It not only retains the original Shell SCGP waste heat boiler of coal characteristics of strong adaptability, and ability to scale up easily, but also absorb the advantages of the existing quench technology. Underground coal gasification[edit] Main article: Underground coal gasification Underground coal gasification is an industrial gasification process, which is carried out in non-mined coal seams using injection of a gaseous oxidizing agent , usually oxygen or air, and bringing the resulting product gas to surface through production wells drilled from the surface. The product gas could to be used as a chemical feedstock or as fuel for power generation. The technique can be applied to resources that are otherwise not economical to extract and also offers an alternative to conventional coal mining methods for some resources. Compared to traditional coal mining and gasification, UCG has less environmental and social impact, though some concerns including potential for aquifer contamination are known. Carbon capture technology[edit] Carbon capture, utilization, and sequestration or storage is increasingly being utilized in modern coal gasification projects to address the greenhouse gas emissions concern associated with the use of coal and carbonaceous fuels. In gasification , on the other hand, oxygen is normally supplied to the gasifiers and just enough fuel is combusted to provide the heat to gasify the rest; moreover, gasification is often performed at elevated pressure. The resulting syngas is typically at higher pressure and not diluted by nitrogen, allowing for much easier, efficient, and less costly removal of CO_2. CO_2 capture technology options[edit] This section does not cite any sources. August Learn how and when to remove this template message All coal gasification-based conversion processes require removal of hydrogen sulfide H_2S; an acid gas from the syngas as part of the overall plant configuration. Typical acid gas removal AGR processes employed for gasification design are either a chemical solvent system e. Process selection is mostly dependent on the syngas cleanup requirement and costs. For significant capture of CO_2 from a gasification plant e. For gasification applications, or IGCC, the plant modifications required to add the ability to capture CO_2 are minimal. The syngas produced by the gasifiers needs to be treated through various processes for the removal of impurities already in the gas stream, so all that is required to remove CO_2 is to add the necessary equipment, an absorber and regenerator, to this process train. In combustion applications, modifications must be done to the exhaust stack and because of the lower concentrations of CO_2 present in the exhaust, much larger volumes of total gas require processing, necessitating larger and more expensive equipment. The CO_2 will be sent by pipeline to depleted oil fields in Mississippi for enhanced oil recovery operations. Ninety percent of the CO_2 produced will be captured using Rectisol and transported to Elk Hills Oil Field for EOR, enabling recovery of 5 million additional barrels of domestic oil per year. Plants such as the Texas Clean Energy Project which employ carbon capture and storage have been touted as a partial, or interim, solution to climate change issues if they can be made economically viable by improved design and mass production.

4: Full text of "Products and by-products of coal"

Coal ash, also referred to as coal combustion residuals or CCRs, is produced primarily from the burning of coal in coal-fired power plants. Coal ash includes a number of by-products produced from burning coal, including: the type of by-product, the processes at the plant and the regulations the.

Carbon Monoxide CO Carbon monoxide, or CO, is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. The figure below shows the contribution of various sources to the emissions of CO: Sources of Carbon Monoxide Emissions Carbon Monoxide is a component of motor vehicle exhaust, which contributes about 55 percent of all CO emissions nationwide. Other non-road engines and vehicles such as construction equipment and boats contribute about 22 percent of all CO emissions nationwide. Higher levels of CO generally occur in areas with heavy traffic congestion. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Other sources of CO emissions include industrial processes such as metals processing and chemical manufacturing , residential wood burning, as well as natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are sources of CO indoors. The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. An inversion is an atmospheric condition that occurs when the air pollutants are trapped near the ground beneath a layer of warm air. These gases dissolve easily in water. Sulfur is prevalent in all raw materials, including crude oil, coal, and ores that contain common metals, such as aluminum, copper, zinc, lead, and iron. SOx gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore. SO2 dissolves in water vapor to form acid and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment. Sources of Sulfur Dioxide Emissions Nitrogen Oxides NOx Nitrogen oxides, or NOx, is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels as shown in the figure below. Sources of Nitrogen Oxides Emissions Although many of the nitrogen oxides are colorless and odorless, one common pollutant, nitrogen dioxide NO2 along with particles in the air can often be seen as a reddish-brown layer over many urban areas. Smog over Los Angeles Credit: Due to the phase-out of leaded gasoline, metals processing is the major source of lead emissions to the air today. The highest levels of lead in air are generally found near lead smelters devices that process lead ores. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers. Lead is a metal found naturally in the environment as well as in manufactured products. Lead is used in the manufacturing of many items, including glass, rubber, paint, batteries, insecticides, plumbing and protective shielding for X-rays. Particulate Matter PM Particulate matter PM is the general term used to describe a mixture of solid particles and liquid droplets found in the air. Some particles are large enough to be seen as dust or dirt. Others are so small they can be detected only with an electron microscope. Different sizes of Particles include: PM can be emitted directly or formed in the atmosphere. Different Sources of Particles include: Examples of primary particles are dust from roads or black carbon soot. Examples of secondary particles are sulfates formed from SO2 emissions from power plants and industrial facilities; nitrates formed from NOx emissions from power plants, automobiles, and other combustion sources; and carbon formed from organic gas emissions from automobiles and industrial facilities. The chemical composition of PM depends on location, time of year, and weather. Generally, primary particles make up coarse PM and secondary particles make up most of fine PM.

5: Products of Combustion | EGEE Energy Conservation and Environmental Protection

There are other dangerous by products of coal burning. Of course the actual types of by product depend on the nature and quality of the coal that is burnt, and its energy content. Most coal burning releases nitrogen dioxide and sulphur dioxide.

These include coal ash fly ash and bottom ash , boiler slag, and flue-gas desulphurization products. Storage of the remainder is complicated by the presence of toxic and radioactive compounds in the waste. Coal combustion wastes contain a variety of toxic compounds such as arsenic, cadmium, chromium, cobalt, lead, mercury, selenium, thorium and uranium, as well as dioxins and poly-aromatic hydrocarbons PAHs. Despite the presence of these toxic compounds, this waste has not been regulated by the EPA as hazardous waste and has often been kept in large impoundments near coal-fired power plants without sufficient containment and in some cases at sites with a high risk of flooding in the area. Furthermore, waste storage generally includes no clear plan to render waste safe. This means they are by default plans to store waste forever , a recipe for eventual failure. In the EPA conducted a large-scale survey assessing the risks 2. Furthermore, after a detailed analysis of this survey by environmental groups, the EPA refused to release the locations of the most toxic coal waste storage sites although they began informing local residents. However, in September the EPA announced that they were planning to overhaul the rules for coal-fired plants for the first time since to include new limits on toxic metal discharges. In advance of these changes the EPA and other have released studies documenting water contamination from coal waste at sites in 34 states. Some coal combustion wastes are recycled, while others go into long-term storage. For example, the fly-ash spill in Tennessee plugged the Emory River, fouled approximately acres, and will require the removal of 5. Coal ash is divided into fly ash which is captured from chimneys of the coal plant and bottom ash which is removed from the bottom of coal furnaces. Fly ash used to be released into the atmosphere but is now mostly captured prior to release. However, the use of fly ash as a building material is quite controversial with proponents claiming that it reduces the cost of concrete and is better than impounding the toxins in a landfill and opponents pointing to numerous studies showing the highly variable quality of fly ash for concrete and risks associated with the presence of these toxins in the concrete. In addition to bottom ash, older coal furnaces produce what is known as boiler slag which is a hard black granular material that forms when molten ash comes in contact with cooling water. Boiler slag can be used as inert filler in materials such as asphalt and concrete. While there is a demand for this waste product, supplies are dwindling as new coal combustion methods predominate. This process produces waste which consists primarily of calcium sulfate or calcium sulfide. This waste can be used to make synthetic gypsum in applications such as the creation of concrete and wallboard. While there is an interest in increasing the amount of coal combustion wastes that are reused, the market for gypsum is close to saturation. Recently there has also been interest in recyling the uranium found in coal combustion wastes which would reduce the radioactivity of the waste, but may produce additional toxic byproducts during purification of the uranium. All of these are " pulverized coal combustion " plants that are decades old. Chena and UAF dispose of their wastes outside city limits via contractors. Waste Disposal in Alaska is monitored by the Department of Environmental Conservation which maintains publicly available records of operation plans, and inspection reports for waste facilities. According to these documents and to unpublished interviews the majority of coal combustion wastes in Alaska are used as fill in some manner or another. The three military bases dispose of these wastes in nearby unlined landfills, and Eielson also uses them to cap an asbestos landfill. The mine-mouth plant in Healy returns the waste to Usibelli where it is placed back into one of the mines. The UAF used to use their coal combustion wastes as fill for things like driveways, parking lots, and roads on campus. Currently a contractor is responsible for the disposal of these wastes and all the waste currently goes to filling pits created by mining peat. The Chena power plant in Fairbanks uses a different contractor to dispose of their coal combustion wastes, but they go to the same location. Environmental Impacts As noted above, coal combustion wastes may contain a number of hazardous compounds. However, the concentrations of these compounds and their propensity to leach into the environment vary with the type of coal being burned, and the type of waste being disposed of e. Copyright held by photographer.

6: Gasification by-products | Global CCS Institute

Similarly, the gases from our coking plant can be used in many different ways. The gas must first be cooled, cleaned and washed. Benzene is a product of our light-weight-oil system.

ND, not determined The use of petroleum coke with high V and Ni contents significantly increases the amount of Ni and V in by-products, including slag samples, compared with the average range of IGCC slags trace element concentrations for gasification of coal alone. In fly ashes and fine high-carbon particulates, a high concentration of lead, zinc and cooper is also observed. While the amount of fine particulates produced in slagging gasification units is significantly less than in pf combustion systems, the concentrations of Zn, Pb, As, Sb, Cd, Cu, V, Ni, and Mo in fly ash are around one order of magnitude higher than the concentrations of PCC fly ashes [33]. Of course, for similar coals, in absolute values the total amount of metals and semi-metals present in gasification and combustion by-products are similar, or even lower in IGCC with coal-petcoke feed. Relatively high contents of Pb, Sb, Zn in the Puertollano ashes is directly linked with high content of these elements in the Puertollano coal. Leaching behaviour of by-products obtained from gasification of coal with other feedstock has also been studied [30, 34]. Six samples two slags and four high-carbon particulates were obtained from a commercial gasifier using coal and pet coke [35]. Column leaching tests were used to simulate the reaction of granular materials during exposure to fluids such as landfill leachate, acid rain, or acid mine drainage. Two of the six samples generated in a commercial IGCC unit had relatively little effect on leachate pH. The neutral and acid leachants generated acidic leachates from the other four samples. The maximum leachate concentrations of Fe, Ni and Zn were very high for the acidic IGCC samples generated from a mixture of coal and petroleum coke. The maximum concentration of these elements, particularly Ni, was much higher than from the alkaline samples or from typical PC fly ashes. The ions Sb and Zn were moderately or very soluble. The Hg concentration was relatively low. The results of the leaching test for certain elements are presented in Table 20 and compared with standard limits. Leaching characteristics of IGCC solids from gasification of coal-petcoke blends [27]. Shaded data exceeds corresponding shaded colour limit. This could be a constraint in any use in which the IGCC residue was exposed to an aqueous solvent. However, note that the: Characteristics of leachates from Puertollano IGCC plant by-products are available for selected elements only [36]. Leaching tests for germanium Ge shows high extraction yields using pure water due to the unusual occurrence of soluble GeO2. High leaching of Ni is also observed, which exceeds the limits applied for by-products disposal. Nickel is mainly present in sulfides, and an oxidizing media is needed in order to obtain acceptable extraction yields. Vanadium is mainly associated with the aluminium-silicate matrix, and an alkaline extractant is required for the selective extraction. Therefore, these residues require additional treatment before their disposal. Gasification residues resulting from the use of delayed oil sands coke, Genesee sub-bituminous coal, Boundary Dam lignite, and blends were also obtained in the CANMET pilot-scale gasifier [34]. Samples of slag collected after the runs were analysed for their leaching potential using the TCLP procedure. Results presented in this section indicate that gasification slags are generally non-leaching or low-leaching materials for most of the standard leaching tests applied. Some of the slags obtained from coal-petcoke blends gasification, however, have relatively high leachability and could be an issue for disposal options. While samples of slag and other solid by-products are typically difficult to obtain, some recent work undertaken as part of the CCSD test of Australian coals in a Siemens pilot-scale gasifier, provided an opportunity to produce samples of slags and other process solids under realistic conditions. As part of that work, the samples were characterised in terms of their concentrations of trace elements, and some preliminary measurements of their leachability were made. In related CCSD work [37], some samples of slag from an Australian coal S gasified in the Buggenum IGCC Shell gasifier were also obtained, and characterised in terms of their trace element concentrations and leachability. This section presents an overview of the relevant outcomes of these activities. Details regarding the testing of Australian coals in the Siemens pilot-scale gasifier can be found in [38, 39]. These tests produced a slag product, which was quenched and removed through a slag hopper, and a second stream of finer solid particles, which were removed from the gas and washed out with the quench water. These samples were analysed using a number of chemical and microstructural techniques, including chemical analysis for bulk composition and trace elements, X-ray diffraction XRD , and leaching behaviour using the procedure developed by CSIRO []. The coal samples and their gasification residues are listed in Table Slag discharged through the slag tap is the major mineral matter product for all of the tests. However, fine slag from the coal test contains a significant amount of apparently unmelted solids, including solid CaO as result of fluxing this coal with limestone CaCO3. This coal also produced a relatively small proportion of process water solids. This result indicates that, under the conditions used in these tests, the coal mineral matter was almost fully melted to produce a coarse glassy slag product.

7: Coal | Products - Coke, Coal Tar And Coal Gas | Uses| Properties of Coal

The recycling of coal combustion by-products, or coal utilization by products (CUB) which includes the solid residue from coal and gasification, is a practice that can play a significant role in maintaining both the cost advantage and environmental acceptability of coal-fired power plants.

The mining process itself produces waste coal or solid mining refuse, which is a mixture of coal and rock. The mining process also produces liquid coal waste, which is then stored in impoundments. Forms of waste from coal mining and combustion Waste coal According to the Department of Energy, waste coal is "Usable material that is a byproduct of previous coal processing operations. Waste coal is usually composed of mixed coal, soil, and rock mine waste. Most waste coal is burned as-is in unconventional fluidized-bed combustors. For some uses, waste coal may be partially cleaned by removing some extraneous noncombustible constituents. Examples of waste coal include fine coal, coal obtained from a refuse bank or slurry dam, anthracite culm, bituminous gob, and lignite waste. Another form of liquid coal waste is acidic mine runoff. Both forms of liquid coal waste are disposed of in a landfill at the mine site. Each year coal preparation creates waste water containing an estimated 13 tons of mercury, tons of arsenic, tons of beryllium, tons of cadmium, and tons of nickel, and tons of selenium. On top of emitting 1. A power plant that operates for 40 years will leave behind 9. With modern air pollution controls, airborne toxins are captured through filtration systems before they can become airborne, and contained in a fine ash called coal ash, fly ash, or coal combustion waste. As a result, heavy metals such as mercury are concentrated in what the EPA considers "recycled air pollution control residue. Often dry material such as fly ash is added to stabilize the sludge for transport and landfill storage. As rain filters through the toxic ash pits year after year, the toxic metals are leached out and pushed downward by gravity towards the lining and the soil below. An EPA study found that all liners eventually degrade, crack or tear, meaning that all landfills eventually leak and release their toxins into the local environment. Coal ash-waste ponds and coal waste landfills are leaching toxins into streams and drinking water, the report noted. As reported in the Christian Science Monitor: The report concluded that the EPA must regulate coal ash waste in order to protect the public and the environment from the negative effects of coal waste. Some regulators have used laws like the Clean Water Act to combat such pollution. But those laws can prove inadequate, say regulators, because they do not mandate limits on the most dangerous chemicals in power plant waste, like arsenic and lead. Lobbyists and some politicians blocked the EPA from creating stricter regulations for power plant waste in The study revealed that all of them are contaminating ground water with toxic pollutants, in some cases with over times the allowable levels according to state standards. The contaminants include the toxic metals arsenic, cadmium, chromium, and lead, which can cause cancer and neurological disorders. The study was based on data submitted by Duke Energy and Progress Energy to state regulators. Department of Environment and Natural Resources is attempting to confirm the results before determining whether current state law can mandate corrective action. The suit accuses the companies of committing conspiracy and fraud, battery, negligence, infliction of emotional distress, and the creation of a nuisance. Most of the sludge spilled onto the West Virginia river bank, about miles upstream from Washington, D. The sludge caused some discoloration of the river, but there were no signs of harm to fish or drinking water supplies. The agency may fine the company. Officials believe the landfill is leaking radioactivity into a shallow underground aquifer. If the uranium and radium found in the coal combustion waste is causing elevated radioactivity in groundwater, it would be a sign that the liner is failing. Authorities say there is no immediate threat to local residents. The ash pile is feet tall and holds several million tons of coal waste. Coal contains small amounts of uranium and thorium, which are concentrated "up to 10 times" in coal ash, a waste product of burning coal. Coal ash can leech radioactivity into the surrounding groundwater and soil, depending on where it is disposed. Finkelman thinks that radiation is "more of an occupational hazard than a general environmental hazard The miners are surrounded by rocks and sloshing through ground water that is exuding radon. The spill, which TVA said originated from a gypsum treatment operation, released about 10, gallons of toxic gypsum material, some of which spilled into Widows Creek and the nearby

Tennessee River. Photo courtesy of United Mountain Defense. Officials said 4 to 6 feet of material escaped from the pond to cover an estimated acres of adjacent land. A train bringing coal to the plant became stuck when it was unable to stop before reaching the flooded tracks. Company officials said the pond had contained a total of about 2. However, the company revised its estimates on December 26, when it released an aerial survey showing that 5. For twelve years prior, Constellation had dumped billions of tons of waste ash from its Brandone Shores coal-fired power plant into an unlined mine pit. County tests found that 23 wells in the area had been contaminated with metals such as arsenic, cadmium and thallium, all components fly ash. The settlement requires that Constellation connect 84 households to public water, create two trust funds to compensate affected property owners, restore the former quarry site, and cease all future deliveries of coal ash to the site. The sludge smashed through concrete seals the company had built to contain a spill, then burst out two mine entries and into nearby creeks. The spill swamped lawns along the six miles of the Coldwater Creek, coated the banks and bottom of Coldwater and neighboring Wolf Creek to thicknesses of up to six feet, and suffocated aquatic life, including salamanders, frogs, fish and turtles. More than people who took part in lawsuits against the coal company reached out-of-court settlements and agreed not to disclose the terms. On February 25 the West Virginia Department of Environmental Protection issued a notice of violation for the spill, which took place in Raleigh County. The Department issued a similar violation in for a spill by the company. According to the study, the Bush Administration only made a portion of the data available, hiding the true extent of the health risks associated with coal ash disposal sites. A EPA assessment report found that people living near coal ash dump sites have as high as a 1 in 50 chance of getting cancer from drinking water contaminated by arsenic. EIP report says Pennsylvania coal ash dump is not adequately protected against groundwater contamination The May study released by the Environmental Integrity Project EIP and Earthjustice said that a acre coal ash dump in Upper Mount Bethel Township, PA was not properly lined and did not have adequate controls to prevent groundwater contamination. The report comes from previously unreleased data collected by the Environmental Protection Agency. Army Corps of Engineers began using coal ash to melt the thick ice on the Platte River in Omaha, Nebraska, in an attempt to prevent ice jams and severe flooding. Bruce Nilles of the Sierra Club notes "This strikes us as a strange and dangerous move â€” one community is going to add coal ash to their water while many others are worried about how it will affect their water supplies. By analyzing more than water samples collected over the month period, the Duke team found that high concentrations of arsenic from the TVA coal ash remained in the water trapped within river-bottom sediment â€” long after contaminant levels in surface waters dropped back below safe thresholds. The authors argued that these findings were evidence that coal ash waste ought to be designated a hazardous substance by the EPA. The research was funded by the National Science Foundation. The report specifically cited 29 sites in 17 states where the contamination was found. As a press release about the report read: Now new information indicates that the chemical has readily leaked from coal ash sites across the U. This is likely the tip of the iceberg because most coal ash dump sites are not adequately monitored. About 2, cubic yards of ash reportedly reached the water. The data revealed there are at least more coal ash ponds than previously acknowledged by the agency. Previously the EPA admitted there were ponds that existed, however, the new numbers the FOIA request revealed increased that total to 1, Additionally, the EPA had previously not stated how many ponds were unlined. The data released indicated that at least ponds currently operate without a liner to prevent hazardous chemicals from reaching drinking water sources. The agency was told by the US Department of Homeland Security not to release the information, citing unspecified national security concerns. The locations of other hazardous sites, such as nuclear power plants, are publicly available. The rating applies to sites at which a dam failure would most likely cause loss of human life, but does not include an assessment of the likelihood of such an event. No Tennessee Valley Authority sites were included on the list. EPA relied on self-reporting by utilities to rank the facilities, and TVA classied all of its dump sites - including Kingston Fossil Plant - as "low hazard. TVA reclassified most of its other dumps as "significant" hazards, meaning that a dam failure would likely cause economic loss and environmental damage. TVA had initially ranked all its sites as having "low" hazard potential. This list is organized alphabetically by company.

8: Coal Ash Reuse | Coal Ash (Coal Combustion Residuals, or CCR) | US EPA

The by-products of coal gas manufacture included coke, coal tar, sulfur and ammonia; all useful products. Dyes, medicines, including sulfa drugs, saccharin and many organic compounds are therefore derived from coal gas.

9: Electricity Generation and By-products | ND Studies Energy Curriculum

The by-products of coal serve as the basis for many items used daily by Americans. Provided by National Energy Foundation.

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