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(NENRYOKYOKWAISHI)

SECTION 2

ORIGINALS AND ABSTRACTS

RECENT PROGRESS OF COAL WASHING AND THE COKE INDUSTRY.

T. IYOKU.

An idea of the present position throughout the world of coal cleaning can adequately be obtained in the excellent book on 'The Cleaning of Coal' written by Messrs. W. R. Chapman and R. A. Mott, from which publication the statistics of washeries is reproduced below in Table I.

Table 1.—Different Types of Washers Built.

| | Jig Washers. | | | | | | | | | |
|-----------------|---------------|-----------------|----------------|-----------------|---------------|-----------------|----------------|-----------------|---------------|-----------------|
| | Lührig type. | | Humboldt type. | | Baum type. | | Miscellaneous. | | Rheolaveur. | |
| | No. of plants | Hourly capacity | No. of plants | Hourly capacity | No. of plants | Hourly capacity | No. of plants | Hourly capacity | No. of plants | Hourly capacity |
| France | 62 | 3,778 | 45 | 2,412 | 4 | 250 | 1 | 90 | 52 | 5,055 |
| Belgium | 75 | 5,508 | 9 | 499 | 2 | 180 | — | — | 47 | 3,655 |
| Germany | 435 | 29,197 | 192 | 19,100 | 160 | 15,840 | 12 | 2,050 | 6 | 870 |
| Great Britain | 314 | 11,071 | 18 | 1,352 | 140 | 13,787 | 154 | 5,025 | 17 | 1,295 |
| U. S. A. | — | — | — | — | — | — | — | — | 12 | 3,055 |
| Other countries | 34 | 2,155 | 29 | 1,975 | 47 | 4,100 | 7 | 1,600 | 32 | 2,875 |
| Total | 925 | 52,854 | 293 | 25,338 | 353 | 34,157 | 174 | 8,765 | 166 | 16,805 |

A comparison between the washing capacity and the total production of coal and coke is given in Table 2.

Table 2.—Washing Capacity.

| | A | B | | |
|---------------|-----------------------------------------------|------------------------------------------------------|--------------------------|------------------------------------------------------|
| | Estimated yearly capacity (1,000 tons). | Total coal production (1,000 tons in 1925). | $\frac{A}{B} \times 100$ | Total coke production (1,000 tons in 1925). |
| France | 23,000 | 47,000 | 48.8 | 4,070 |
| Belgium | 19,685 | 23,000 | 85.1 | 4,100 |
| Germany | 133,834 | 135,000 | 99.0 | 26,810 |
| Great Britain | 65,144 | 243,000 | 28.3 | 11,040 |
| U. S. A. | — | — | — | 51,267 |

The figures A/B show the percentages of coal washed as compared with the coal produced. It will be seen that the figures for A/B are highest in Germany, and it will also be noted that the country with the large production of coke has a large capacity of coal washers.

As to the systems of coal washing practice, there is quite a difference among the countries mentioned.

In Great Britain, for instance, it is common to rewash fine coal ($\frac{1}{8}$ " \sim $\frac{7}{8}$ ") after the raw coal is first washed in the main washer; while in France and Belgium, the products are separated into three classes; i.e. clean coal, middlings and refuse, and their contents are respectively as undernoted.

| | Clean coal. | | Middlings | Refuse. |
|-------------|-------------|-----------|-----------|---------|
| Size. | 0-10 mm. | 10-80 mm. | — | — |
| Ash content | 7-12% | 4-8% | 30-35% | 60-80% |

The fact that the smaller the size of the clean coal and the refuse, the more ash content in the former and the less in the latter, is very similar to the practice in Japan.

In Germany, coal dust is commonly separated out by a cyclon before washing, and it is blended with the washed fines. According to this system, the washing water is free from dust and the difficulty of disposing of the slurry is, therefore, much reduced and the water content of the washed fines becomes low.

Though it is a common practice to rewash fine coal (e.g. less than $\frac{3}{8}$ ") in Great Britain, France as well as in Belgium, it has not as yet been employed in our country. The author believes that this system of washing must also be valuable for Japanese coal, because the refuse has a smaller ash content in the finer size, as shown in Tables 3 and 4, which give the results of experiments conducted at the Yawata Imperial Iron Works.

Table 3.—Experimental Results of Coal Washing by Baum.

| | | >20-mm. | 20-10 | 10-6 | 6-3 | 3-1.5 | 1.5-0.6 | 0.6-0.3 | <0.3 |
|-------------|----------|---------|-------|-------|-------|-------|---------|---------|------|
| Raw coal | amount % | 4.87 | 20.64 | 16.39 | 20.31 | 13.24 | 11.81 | 6.48 | 6.27 |
| | ash % | 15.2 | 16.3 | 18.3 | 14.4 | 14.2 | 18.4 | 21.3 | 27.9 |

| | | | | | | | | | |
|-------------|----------|------|-------|-------|-------|-------|-------|------|------|
| Washed coal | amount % | 5.92 | 23.04 | 16.38 | 19.31 | 12.61 | 10.08 | 5.99 | 6.85 |
| | ash % | 13.1 | 13.0 | 11.8 | 10.7 | 10.7 | 13.1 | 16.5 | 23.1 |
| Refuse | amount % | 9.13 | 33.66 | 18.45 | 18.47 | 8.82 | 5.44 | 2.85 | 3.18 |
| | ash % | 59.6 | 63.4 | 68.4 | 67.1 | 68.5 | 63.8 | 52.2 | 42.3 |

Table 4.—Experimental Results of Coal Washing by Humboldt.

| | | >20-mm. | 20-10 | 10-6 | 6-3 | 3-1.5 | 1.5-0.6 | 0.6-0.3 | <0.3 |
|-------------|----------|---------|-------|-------|-------|-------|---------|---------|------|
| Raw coal | amount % | 2.26 | 16.43 | 16.02 | 20.74 | 15.12 | 13.14 | 8.45 | 8.12 |
| | ash % | 22.32 | 17.09 | 14.06 | 14.80 | 11.3 | 12.6 | 17.9 | 19.0 |
| Washed coal | amount % | 4.12 | 25.47 | 16.33 | 15.94 | 13.05 | 9.95 | 6.69 | 8.45 |
| | ash % | 16.40 | 12.00 | 10.5 | 9.6 | 8.4 | 8.82 | 10.2 | 17.8 |
| Refuse | amount % | 6.20 | 26.22 | 16.50 | 15.73 | 10.43 | 8.98 | 8.19 | 7.50 |
| | ash % | 60.24 | 55.20 | 60.6 | 66.1 | 59.2 | 47.9 | 32.9 | 31.2 |

According to these experimental results, the author has designed a new type of washer which has the outlet for refuse on a different side.

The coke oven system which has a narrow width, and has been discussed and thought to be advantageous, is not developing as much as was expected, and the wide oven seems again to be prevailing in Europe. Installations with chambers of 400-450 mm. width accounts for 72.5% of the total coke ovens in Germany.

The systems employed for dry quenching are the Sulzer, Collin and Hellar-Bamag. Although the dry method of quenching generally reduces the coke breeze and is favoured in the European coke works, it is not thought of in the same way in the United States of America, owing, probably, to the different nature of the coal charged.

(The Yawata Imperial Iron Works).

FUEL IN THE ELECTRIC LAMP INDUSTRY.

M. YAMAKI.

The process of manufacturing electric lamps can be divided into three operations, namely, first, the production of the filament, second, the making of the glass bulbs, and third, forming them into electric lamps.

The fuel consumed in the operations is to a great extent used in making the glass bulbs, while it is scarcely utilized in the production of filament.

Special precautions are necessary in the selection of fuel for each process of lamp making, as for example, it is better to use a fuel of high calorific value for annealing the glass bulb, while fuel of high flame temperature is preferable in cutting the bulb mouth.

The undernoted table shows how the fuel is selected for each process in lamp manufacture.

| | Process. | Fuel |
|--------------------|-------------------------------------------------|----------------------------------------------------------------------------------------|
| Glass bulb making. | Melting raw materials. | Coal or producer gas. |
| | Cutting the bulb mouth. | Water gas. |
| | Annealing. | Coal gas. |
| Filament making. | Preliminary drying of tungsten oxide. | Steam. |
| | Drying of the tungsten oxide. | Coal gas. |
| | Sintering. | { Electricity or hydrogen. |
| | Swathing. | |
| | Process. | Fuel. |
| Formation of lamp. | Mounting the metallic cap into the glass globe. | Fuel oil. |
| | Gradual cooling. | Coal gas. |
| | Fusing for enclosure. | |
| | { common glass. | Coal gas or water gas. |
| | { hard glass. | { Combustion of coal gas, using oxygen. Combustion of hydrogen, using oxygen. |

In the process of fusing the glass for closing the lamp mouth, the author found that the operation velocity was higher by about 15–20% when employing water gas only than when mixed with coal gas.

The analyses of the gases are shown in the following table.

| | Water gas. | Mixed gas. (coal gas + water gas). |
|-------------------------------------|-------------|---------------------------------------|
| CO ₂ | 2.8% | 5.50% |
| C _m H _n | 0.4% | 3.20% |
| O ₂ | 0.6% | 0.80% |
| CO | 40.4% | 16.10% |
| CH ₄ | 3.3% | 19.11% |
| H ₂ | 48.7% | 33.60% |
| N ₂ | 3.8% | 21.69% |
| Total | 100.0% | 100.0% |
| B.T.U. { | Gross | 365.90 |
| | Net | 299.61 |
| | | 398.60 |
| | | 325.42 |

Fuel saving is another important question in the lamp manufacturing industry. Until recent times, the raw material for the glass bulbs of electric lamps was commonly melted in the pot furnace, which was heated by direct coal firing with a very low thermal efficiency. It is worth pointing out that the author has reduced fuel consumption by about 20%, employing a tank furnace instead of a pot for melting the raw material; the tank furnace is heated by producer gas, a waste heat boiler being installed.

Finally, the author suggests the following as methods of possible improvement in fuel economy in this industry, namely, the employment of oxygen for combustion of the fuel gas, as well as making producer gas, a higher thermal conductivity of the glass fusing pot, and a better heat insulation of the tank furnace wall.

CURRENT NEWS.

MARCH MEETING OF THE SOCIETY.

The March Meeting of the Society was held on the 15th of last month, and the following papers were read and discussed on that occasion.

1. Researches regarding fuel chemistry carried out in the Physical and Chemical Research Institute, by Viscount Ohkochi, Director of the said Institute. An abstract of his Paper will appear in the next issue of this Journal.

2. Experiments relating to the extinguishing of fires in oil tanks, by Captain Kajimoto, Naval Engineer. The experiment carried out for extinguishing fires in oil tanks with frothing reagents was fully dealt with and illustrated by a cinematograph film. The test was undertaken at a naval station and a 1,000 gallon tank was employed in the experiments. The speaker discussed in detail the method of operation, construction of mixing devices as well as the components and quantities of the agents.

The Meeting was very well attended.

(S. T.)

ANNUAL MEETING OF THE SOCIETY OF CHEMICAL INDUSTRY OF JAPAN

The thirty-third Annual Meeting of the Society of Chemical Industry was held in Tokyo for four days commencing on the fourth of April. A little more than 120 papers were read, and four special lectures were delivered. Abstracts from those papers appertaining to fuel technology are given below.

Manufacture of Ethylene, by Messrs. Kashima, Takahashi and Matsuda. The authors gave their experimental results on the production of ethylene using denatured alcohol of 91% purity, claiming that the cost of production is only ¥ 0.75 per 1,000 litres and that the process can be carried on as a paying proposition on a commercial scale. The purity of the product is 97%, and will be a good substitute for acetylene for welding purposes.

The Inflamating Constituents of Pitch, by Mr. Sumimoto, Naval Fuel Research Laboratory. The fact that pitch inflamates human skin and causes a cancer is well known, but as to its cause no explanation has as yet been forthcoming. To make clear this point, the author carried out an examination of its constituents not only from a chemical but also a medical point of view. He has succeeded in isolating some of them which have been identified as cresols, xyleneol, pyridine and piperidine, etc.

The Thermal Decomposition of Cresols, by Mr. Kosaka, Tokyo Imperial University. This forms part of the author's investigations on the mechanism of tar formation during the distillation of coal. In this paper, he reported that cresols are decomposed almost all at 900°C. into phenol, benzol, toluol, naphthalene, diphenyl, anthracene and other gases. The rate of decomposition was nearly the same with both para-and ortho-cresol, while meta compound

was somewhat different from the other isomers.

The Hydrogenation Products of Phenols of Low Temperature Tar, by Dr. Oshima and Mr. Ando, Imperial Fuel Research Institute. In order to make clear, on the one hand, their constitution, and on the other hand, to find a new field of utilization of phenols in low temperature tar, this problem was fully studied by the authors. Cresols are changed almost theoretically into methylcyclohexanol when these compounds are hydrogenated under high temperature and pressure using nickel as catalyser. The products will be decomposed into methylcyclohexane and water at higher temperatures with an excess of hydrogen. However, if the amount of hydrogen is insufficient, methylcyclohexene is productd. For the catalyser, reduced nickel and oxides were tested and the former was found to be reactive at a lower temperature than the latter.

Addition of Inorganic Compounds to Coal to reduce Phenol Content in Low Temperature Tar, by Mr. Ban, Imperial Fuel Research Institute. The presence of a large amount of phenols in low temperature tar is an obstruction when it is intended to use it as a Diesel fuel. A great number of processes for their removal were investigated by various researchers, yet the elimination method in the course of carbonization was scarcely considered. In his paper, the author explained how he succeeded to diminish the content of phenols in low temperature tar, by mixing some inorganic compounds to the coal before its carbonization.

Hydrogenation of Aromatic Hydrocarbons, by Dr. Tanaka and Messrs. Kobayashi and Takizawa, Tokyo Imperial University. It is said that to add hydrogen in place of double bond in an aromatic ring, is very difficult. The authors carried out experiments and found that the addition of Japanese acid clay facilitates this hydrogenating reaction. As an explanation of this fact, the authors suggested that the catalytic adsorptive power of the clay, which makes the connecting ring of aromatic double bond unstable, and such compounds, are easily hydrogenated.

Hydrogenation of Fushun Shale Oil, by Dr. Tanaka, and Messrs. Kobayashi and Tanaka, Tokyo Imperial University. The authors investigated the effect of the presence of Japanese acid clay in the hydrogenation of Fushun shale oil under high pressure and temperature, and also carried out experiments to produce gasoline by the destructive hydrogenation of oil. The results show that so far as the yield of gasoline is concerned, a suitable iron catalyser might be used with better result than nickel.

Solubility of Hydrogen under High Pressure in various Liquids, by Messrs. Kobayashi and Tanaka, Tokyo Imperial University. Lately, the investigations appertaining to hydrogenation under high pressure have made remarkable progress, though the solubility of this element under high pressure has been left untouched. The authors found the relation between solubility, pressure and temperature under different conditions with various liquids.

Auto-Ignition Temperature under High Pressure, by Dr. Oshima and Mr. Suwa, Imperial Fuel Research Institute. Of Diesel engine oil, the determination of the auto-ignition temperature under an ordinary pressure has been measured and reported previously by one of the authors. The present authors emphasised that such a test must be done under a high pressure to meet the actual requirements. Bearing this point in mind, they designed and constructed a new type of apparatus, which served the purpose quite well. In the paper, the construction of the instrument is fully described and some results of the measurements carried out are given, when using varieties of oil, low temperature tar as well as finely pulverized coal.

Considerations on the Oxidation of Crude and Refined Transformer Oils, by Mr. Midzushima, Electric Research Laboratory. The author considers that the difference in the acidified properties by oxidation between crude and refined oil is due to the content of sulphur compounds, because the latter, which naturally contains a very small amount of sulphur, is more liable to be oxidised than the former. Oxidation tests were undertaken by mixing both oils in various proportions, though he failed to obtain sufficient support to qualify his theory.

Thermo-Spring Balance, by Dr. Oshima and Mr. Fukuda, Tokyo Imperial University. This paper describes a new type of thermo-balance designed and constructed by the authors. The apparatus consists of three main parts, viz. a quartz glass helical spring, a sample dish and an iron core with a solenoid around it, to keep the iron core by means of an electric current at a definite position against the contraction of the spring caused by the decrease of the weight of the sample. The balance operates quite well, and its sensibility is 0.5 milligramme.

Thermo-Chemical Analysis of Coke, by Messrs. Fukuda and Kaneko, Tokyo Imperial University. Using the thermo-spring balance referred to above, the authors observed the change of the weight of coke in the course of heating. They also investigated the effect of ash in coke upon the reactivity of coke toward carbon dioxide, and concluded that ash plays the role of catalyser.

The Effect of the Rate of Heating upon the Swelling and Carbonization of Coal, by Mr. Shimmura, Imperial Fuel Research Institute. The experiments were carried out with the Lessing apparatus, and the rate of heating was regulated as 1°, 5° and 10°C. per minute respectively, the temperature range being 300–900° and 300–600°C. The summarized results are as follows:

1. The coke yield did not differ so much in any of the tests.
2. The greater the rate of heating, the larger the tar yield.
3. The yield of gas and gas liquor decreases when the heating rate is increased.
4. The composition and the calorific value of gas is independent of the rate of heating.

Volatile Matter Determination with High Temperature Balance, by Messrs.

Somiya and Hirano, Tokyo Imperial University. In the determination of volatile matter, the three factors, i.e. the heating temperature, rate of heating, and amount of sample used, influence the result very much. The results obtained in the series of experiments show that though the mode of the evolution of volatile matter differs in every coal, yet, if the sample is preheated at 500°, such a difference is easily removed. From this fact, the authors concluded that such a condition as to heat the sample at 950° with a preheating of 500°C. is the most suitable for the determination of volatile matter.

Synthetic Petroleum from Carbon Monoxide and Hydrogen, by Dr. Kobayashi and Messrs. Yamamoto and Ishikawa, Waseda University. After a prolonged study, the authors found, in the synthesis of petroleum, that it is necessary first of all to explain the mechanism of the reaction which can be divided into the following four stages, viz:—

1. Decomposition of carbon monoxide into carbon dioxide and carbon; the latter is in a nascent state.
2. The reaction between carbon monoxide and hydrogen with methane and water as the products.
3. Production of ethylene and acetylene from carbon liberated in the first stage.
4. Condensation of ethylene and acetylene into petroleum.

To obtain the maximum yield of petroleum, it is important to accelerate the reactions of stages 1 and 3 and depress that of 2, as far as possible. For this purpose, the reactions must be carried out separately in the production of ethylene and acetylene on the one hand, and the condensation of those products on the other.

Physico-Chemical Properties of Japanese Acid Clay, by Dr. Kobayashi and Mr. Yamamoto, Waseda University. Though a large amount of Japanese acid clay is used in the refining industry of petroleum, the properties of that material are not yet fully known. The authors carried out an experiment to ascertain the mechanism of adsorption of this clay, and reported on some of the results obtained.

The Precision of the Resistance Thermometer, by Dr. Matsui and Mr. Kambara, Tokyo Technical College. The authors determined the error in the measuring of temperature to one-hundredth degree with a platinum resistance thermometer, and explained the cause of errors. They also pointed out where errors may happen in the use of ordinary new platinum resistance thermometers. (S.T.)

FUEL COMMITTEE CONCLUDED.

The last meeting of the Fuel Committee, which is a division of the Committee on Commercial and Industrial Affairs, was held on the 31st March, and a draft of the conclusions arrived at, to be submitted at the General Meeting of the latter Committee, was prepared after a long discussion. The following

are the items embodied in the draft which were officially published, viz:—

1. Petroleum and its substitutes;
 - a. Exploitation of home resources,
 - b. Rationalisation of the business system,
 - c. Encouragement of home products,
 - d. The establishment of more refineries,
 - e. Investigation of foreign resources,
 - f. Encouragement of research work with regard to the production of substitutes, and establishment on an industrial scale.
2. Coal;
 - a. Exploitation of home resources.
 - b. Rationalisation of the distribution system and business organization,
 - c. Improvement and rationalisation of coal utilisation.
 - d. Investigation of foreign resources.
3. Organization of a standing committee for the investigation of the fuel problem.

The total number of meetings held by the Fuel Committee was 21 since its re-organization in May last year, according to the policy of the present Cabinet, and it was decided at the last meeting to discontinue the deliberations until further notice is given by the Chairman, Mr. Nakajima, M.P.

A General Meeting of the Committee on Commercial and Industrial Affairs will shortly be called, and it seems certain that the report to be submitted by the Fuel Committee will be approved unanimously.

As will be seen in the items cited above, no new scheme is pointed out in particular, but it is gratifying that a definite plan has been propounded, on the basis of which the Cabinet can take proper steps; and this Society is proud of witnessing that almost all of the proposals made to the Government three years ago have been confirmed. (Y.O.)

SELF-SUPPLY OF IRON AND STEEL IN JAPAN.

The undernoted table shows the general tendency of supply and demand of iron in Japan during the last five years.

| Year. | Home demand (1,000 tons). | Import (1,000 tons). | Home supply* (1,000 tons). |
|------------|------------------------------|-------------------------|-------------------------------|
| 1925 | 429 | 116 | 262 |
| 1926 | 564 | 233 | 330 |
| 1927 | 557 | 269 | 287 |
| 1928 | 702 | 335 | 367 |
| 1929 | 786 | 447 | 338 |

* Imperial Iron Works excluded.

As will be clearly seen, the importation is gradually increasing year by year, and as far as possible, it is of great importance to counteract this

tendency and to reduce supplies from outside sources. Bearing this in mind, those concerned in the business have been investigating the subject, and the undernoted general scheme for extending production capacity during three years commencing 1933 has been formulated.

1. The Wanishi Iron Works of the Mitsui Company. The present production is 340 tons per day, and it will be increased to 410 tons from November of this year.

2. The Kamaishi Iron Works of the Mitsui Company. This Works now produces 250 tons daily. By the addition of a blast furnace, production will be further increased to 550 tons in 1932.

3. The Kenjiho Iron Works of the Mitsubishi Company. At this plant 430 tons of pig iron is now produced. By starting up a blast furnace now idle, production will be increased to 550 tons as from the year 1932.

4. The Honkeiko Iron Works of the Ohkura Company. Present daily production amounts to 300 tons, and by improving the installation it will be augmented in 1932 to 410 tons.

5. The Anshan Iron Works of the South Manchurian Railway Company. The daily production here is 600 tons, but an additional blast furnace of a capacity of 500 tons has been installed and was started up on March 9th last. In the year 1931 the production will increase to 800 tons.

The above extensions will make the production of pig iron as follows:—

| Year. | Home demand (1,000 tons). | Probable supply (1,000 tons). | Actual supply (1,000 tons). | Stock (1,000 tons). |
|------------|------------------------------|----------------------------------|--------------------------------|------------------------|
| 1930 | 650 | 674 | 500 (150 import). | 174 |
| 1931 | 800 | 793 | 800 | 7* |
| 1932 | 850 | 860 | 850 | 10* |
| 1933 | 900 | 880 | 900 | 20* |
| 1934 | 950 | 855 | 950 | 65* |
| 1935 | 1,000 | 880 | 1,000 | 120* |

(*) Shows a decrease.

(S.U.)