UNITED STATES DEPARTMENT OF LABOR
Frances Perkins, *Secretary*

BUREAU OF LABOR STATISTICS
Isador Lubin, *Commissioner* (on leave)
A. F. Hinrichs, *Acting Commissioner*

Average Hourly Earnings in the Explosives Industry, June 1944

Bulletin No. 819

[Reprinted from the Monthly Labor Review, March 1945, with additional data]

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Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS,

Washington, D. C. March 21, 1945

THE SECRETARY OF LABOR

I have the honor to transmit herewith a report on average hourly earnings in the explosives industry, June 1944. This report was prepared in the Bureau's Division of Wage Analysis by Edith M. Olsen under the direction of Victor S. Baril.

A. F. HINRICHS, *Acting Commissioner*

HON. FRANCES PERKINS,
Secretary of Labor

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United States Bureau of Labor Statistics

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Average Hourly Earnings in the Explosives Industry, June 1944[1]

Summary

EARNINGS of workers in plants manufacturing smokeless powder, TNT and DNT, black powder, and dynamite ranged from a general average of 92 cents an hour in smokeless-powder plants to $1.08 an hour in the dynamite plants, according to a Bureau of Labor Statistics wage survey. The relatively low average for smokeless-powder plants is accounted for, at least in part, by the fact that this segment of the industry employed large numbers of workers in jobs requiring a less amount of skill or experience and therefore commanding a lower rate of pay. Although the workers in the dynamite branch of the industry had, on the whole, the highest average earnings, averages for the individual occupations were not consistently higher than those for similar occupations in the other three branches.

The production of smokeless powder constitutes the largest branch of the industry in terms of numbers of workers employed. The average earnings for workers studied in 85 selected occupations ranged from 64 cents an hour for janitresses to $1.44 an hour for lead burners. Approximately 60 percent of the workers were classified in those occupations with average earnings ranging from 75 cents to $1.00 an hour. In general, the highest earnings for any one department were paid to maintenance workers. Operators in the processing occupations were paid average earnings ranging from 75 cents an hour for female powder-cutting operators to $1.08 an hour for ether-house operators. Helpers on the powder-making line constituted the largest occupational group, with average hourly earnings of 82 cents for males and 72 cents for females.

The average earnings for individual occupations in the TNT plants studied ranged from 61 cents an hour for janitresses to $1.39 an hour for class A millwrights. Fully half of the workers, however, were employed in occupations having average earnings which ranged from 90 cents to $1.15 an hour. Average hourly earnings of working foremen in the processing departments amounted to $1.14 an hour. Workers in three processing occupations, bi-tri operators, DNT nitrator operators, and fortifier operators, earned an average of $1.11 an hour, the highest average shown for processing operators. The lowest average rate for processing operators (96 cents an hour) was paid to DNT sweat-house operators and to pumpmen in the acid area. Male guards, who constituted a numerically important group among the custodial occupations, earned an average hourly rate of 84 cents.

[1] Prepared in the Bureau's Division of Wage Analysis by Edith M. Olsen under the direction of Victor S. Baril.

The hourly earnings of material-movement workers varied from an average of 77 cents for loaders and unloaders to $1.19 for yard conductors. Workers employed as packers of DNT and TNT earned 93 cents an hour.

Three-tenths of the workers in black-powder plants were concentrated in occupations whose hourly earnings ranged from 90 cents to $1.00, and four-tenths were employed in occupations averaging between $1.00 and $1.15 an hour. The average earnings for individual occupations ranged from 76 cents an hour for watchmen to $1.32 an hour for class A machinists.

Occupational earnings in the dynamite branch of the industry ranged from 76 cents an hour for watchmen to $1.46 an hour for class A millwrights. Nearly two-thirds of the workers studied were employed in occupations whose earnings ranged from 95 cents to $1.20 an hour; well over a fifth were classified in the occupational groups earning average rates in excess of $1.20 an hour.

Characteristics of the Industry

The explosives-manufacturing industry in the United States is relatively small in peacetime. Its production is limited largely to the types of explosives used as blasting agents in mining and quarrying, in railway and other construction work, and in the accomplishment of other projects essential to modern living. Chief among the explosives used for these purposes are black powder and various forms of dynamite. Although both of these peacetime or industrial explosives also have important wartime uses, it is the production of such military explosives as smokeless powder and TNT that constitutes the major part of the wartime explosives industry. The survey on which this report is based covered plants manufacturing both industrial and military explosives, specifically smokeless powder, TNT and DNT, black powder, and dynamite. No attempt was made to cover the many types of explosives that, although of primary importance from a military standpoint, are produced in few plants, or employ only relatively small numbers of wage earners.

TYPES OF EXPLOSIVES

Explosives may be divided into two separate classes—high explosives and mild, or low, explosives. The distinction is made on the basis of the use to which the explosive is put, which in turn depends largely upon the speed of reaction after the charge has been set off. Thus, certain mild explosives, whose rate of combustion is relatively slow, and which build up pressure gradually, are used as propellants. The function of the propellant charge is to exert enough pressure on the shell to force it from the muzzle of the gun at the necessary rate of speed. Explosives which burn with such rapidity as to cause almost instantaneous reaction are classed as high explosives. Because of their extremely rapid reaction, high explosives are not suited for use as propellants. Certain high explosives with great shattering power are used as the bursting charge in many different types of military projectiles. The function of the bursting charge is to shatter the metal shell or bomb case into fragments at the proper point. Small amounts of very sensitive high explosives are also used as detonating agents to initiate explosion of the main propellant or bursting charge.

Smokeless powder is the universally used propellant in fixed and separate loading ammunition for cannon and in small-arms ammunition. It has replaced black powder, which until the latter part of the 19th century was the most common propellant. Smokeless powder is superior to black powder for this purpose in a number of ways; it causes less smoke, leaves less solid residue after burning, and does not absorb as much moisture. Most of the smokeless powder produced in this country has a straight nitrocellulose base and is manufactured in the form of perforated cylindrical grains. Practically the only peacetime use of smokeless powder, aside from the small amount required by the military services, is in sporting weapons.

Trinitrotoluene, commonly known as TNT, is one of the most important military high explosives and is used extensively as a bursting charge in shells, bombs, grenades, torpedo warheads and naval mines. It is also used in military demolition work, and as a constituent of various types of dynamite. Although suitable for blasting, it has not had widespread use for this purpose because of the relatively higher cost as compared with commercial dynamites. TNT has many properties which render it superior to any other known disruptive explosive for military use. It has a low melting point and can be easily melted and poured into shells and bombs, either alone or mixed with ammonium nitrate to form amatol; it does not combine with metals, so that no protective coating is needed to line the inside of the shell. Although it is a powerful explosive, TNT can be manufactured, stored, and transported with comparative safety because it is stable and is relatively insensitive to shock or friction. Dinitrotoluene (DNT) is used principally as a modifying agent in other explosives, notably in smokeless powder for the purpose of reducing moisture absorption.

Black powder is a mild explosive, and although it is no longer in general use as a propellant, it still has important military uses, principally in the manufacture of fuzes and as the igniter charge in artillery primers. Black powder is manufactured on a large scale for peacetime purposes in both granular and pellet form. The bulk of the black powder produced in the United States before the war was used for blasting in mines, quarries, and construction work; small amounts were also consumed in the manufacture of fireworks and ammunition.

Dynamite is a high explosive and is the most important industrial explosive in use at the present time. It does not, however, meet the rigid specifications of a good military high explosive. Its usefulness in military operations is therefore confined to such functions as the destruction of railroads and bridges. Most of the dynamite produced in peacetime is normally consumed for heavy blasting work by the mining and construction industries. There are several types of dynamite, each having properties making it most efficient for specific purposes. For example, dynamites containing a high percentage of ammonium nitrate are particularly suited for use in coal mines where gas explosions are likely to occur, and are therefore approved as "permissible" explosives by the U. S. Bureau of Mines.

WARTIME DEVELOPMENT OF THE INDUSTRY

At the beginning of the present war in Europe, the United States lacked facilities for the production of explosives suitable for military use on the scale required to conduct a war. It became necessary, therefore, for the Government to build a number of large, new plants for the mass production of both smokeless powder and TNT, and, in addition, plants that could produce certain raw materials essential to the manufacture of military explosives. Most of these Government-owned plants were put under the management of private companies experienced in the explosives field and having some of the necessary technical personnel to operate on an efficient basis.

Munitions production during World War I was carried on mainly in the Northeastern States. The great new plants built for the present war are distributed throughout the interior States of the country, where they are less vulnerable to possible enemy attack. Only three States had more than one plant manufacturing smokeless powder or TNT at the time of the Bureau's study; each of these States had two plants. In addition to strategic considerations, the new plant sites were selected with careful regard to such important economic factors as the availability of labor and the supply of natural resources. Most of the large new plants producing smokeless powder and TNT were therefore situated at some distance from already crowded industrial centers.

Establishments manufacturing black powder and dynamite, most of which were in operation before the beginning of the present war, are located near the centers of demand, and are very widely scattered geographically. As the greatest demand comes from the mining industries, the establishments manufacturing these industrial explosives are found throughout the important coal- and metal-mining States. Although most of the States had only one or two plants, there were 10 in Pennsylvania, 5 in Illinois, and 3 each in Ohio, Washington, and Missouri. All of the black-powder and dynamite plants surveyed were privately owned and operated.

Manufacturing Processes

The manufacture of explosives involves both mechanical and chemical processes. There are, of course, some modifications in the manufacturing of any one of the explosives which depend upon the specific use for which they are intended. In addition, some variation in the process may be found among plants producing the same product The following brief descriptions are intended only as very general outlines of the raw materials required and of the processes used in producing the explosives studied in the survey.

SMOKELESS POWDER

The mass production of smokeless powder requires the use of extensive plant equipment. The chief raw materials used in its manufacture are raw cotton or wood pulp, ammonia, sulphuric acid, and ether alcohol. Various other substances are required; some of these are used to bring about the proper chemical reaction during the manufacturing process; others, such as stabilizing and modifying agents, are incorporated into the mixture to produce powders that will meet certain specifications.

A large smokeless powder plant has three main departments: Acid area, nitrocellulose area, and powder-making line. In the acid area, nitric and sulphuric acids are concentrated and mixed before being pumped to the nitrocellulose area for use in the nitration process. The plants may either produce their own sulphuric acid by the contact method or purchase it from other producers. Nitric acid, made by ammonia oxidation, is generally produced by the plant for its own use.

In the nitrocellulose area the cotton or wood pulp, which has been previously purified, is picked into small pieces and put into dryers to reduce the moisture content. The dried cotton is then treated with a mixture of sulphuric and nitric acids (pumped from the acid area) to produce nitrocellulose, the basic ingredient of smokeless powder. The nitrocellulose is next subjected to a series of operations whereby it is thoroughly blended, purified of free acids and foreign substances, and partially dehydrated by wringing. The completely processed nitrocellulose is then transferred to the powder line.

On the powder line, the nitrocellulose is pressed into large blocks and further dehydrated by the addition of a sufficient amount of alcohol to form a colloid with the ether which is added in the next operation. The dehydrated blocks are broken up and the product is mixed by machine with ether and diphenylamine (a stabilizing agent). After mixing, the powder is put through a series of pressing and screening operations designed to bring about a uniformly mixed product. These presses are the preliminary blocking press, the macaroni press, which screens the product, and the final block press. The finishing process varies with the type of powder manufactured. For grain powder (the most common type), the mixture is formed into long strands of varying sizes, by the action of a graining press. These strands are cut into specified lengths on the powder-cutting machine, to make the finished grain powder. The powder is then sent to the solvent-recovery house where most of the ether-alcohol solvent is removed in a preliminary drying operation. The final drying of the powder is accomplished either by drying the powder in warm air, or by circulating warm water through the powder first and then allowing the powder to air-dry for a shorter period of time. The dried powder is finally blended, and in some cases coated with graphite or TNT.

TNT AND DNT

The basic raw material in the manufacture of TNT and DNT is toluene, which is a coal-tar product. The first step in the process of manufacturing TNT, namely the making of strong nitric and sulphuric acids, is carried on in the acid area of the plant which is comparable to the acid area in smokeless-powder plants. A mixture of these acids is then moved to the TNT area, to be used for the nitration of toluene. The nitration process, which is performed in steel vessels where the acid drops through the toluene, may be accomplished by various methods, but the three-stage process is most common. This process involves the nitration of toluene to mononitrotoluene; mononitrotoluene to dinitrotoluene; and finally, dinitrotoluene (DNT) to trinitrotoluene (TNT). The spent acid from the second and third nitrations is fortified or strengthened by the addition of more nitric acid, and is reused. The spent acid from the first or "mono" nitration is concentrated, to recover the sulphuric acid. The resulting crude TNT is purified and neutralized by washing in water. It is then either flaked or crystallized, the moisture being removed during this process. The manufacture of dinitrotoluene or DNT is, of course, very similar; the nitration process is stopped one step sooner than for TNT.

BLACK POWDER

Black powder is a mechanical mixture of charcoal, sulphur, and saltpeter (either potassium nitrate or sodium nitrate). The first operation consists of pulverizing the raw materials. Sulphur and charcoal are usually pulverized in a ball mill and then mixed with the proper proportion of saltpeter, which may either be pulverized or in solution. The material is next ground and crushed in the wheel mill for 3 or 4 hours after which it is pressed into cakes or sheets in a hydraulic press in order to obtain a uniform product. These cakes are broken up or granulated in the corning mill and passed through mechanically operated shaker screens or sieves to obtain grains of uniform sizes. The finishing process for granular powder consists first of drying and then glazing the powder grains by shaking in a cylinder with a small amount of graphite. The finished grain powder is again screened and separated into different grades before packing. Pellet powder is made by molding the black powder into cylindrical pellets under great pressure. These pellets are then dried and are wrapped in paper, waterproofed, and packed.

DYNAMITE

The raw materials used in the manufacture of dynamite are nitric and sulphuric acids, glycerine, ammonium nitrate, sodium nitrate, and various nonexplosive ingredients or "dopes" such as wood pulp. The explosive base of dynamite is nitroglycerin, a high explosive. By itself, nitroglycerin cannot be used with safety as an explosive. Aside from being extremely sensitive to shock, its liquid form makes it very difficult to handle. By mixing nitroglycerin with wood meal, an absorbent carrier, it becomes relatively easy to pack and transport.

In manufacturing dynamite, a pure grade of glycerin is nitrated with a mixture of nitric and sulphuric acids, to form nitroglycerin. For ordinary dynamites, the nitroglycerin is then mixed with the wood pulp, to which has been added either sodium nitrate or ammonium nitrate. For gelatin dynamite, so called because of its jelly-like consistency, nitrocotton is added to the nitroglycerin before mixing with the other ingredients. Dynamite is loaded into paper shells or "cartridges" which have been previously waterproofed with molten wax.

Scope and Method of Study

This report, as previously stated, is based on a Bureau survey of the earnings of workers in establishments manufacturing smokeless powder, TNT and DNT, black powder, and dynamite. The survey included virtually all plants engaged in the production of these explosives, and employing nine or more wage earners. The data for one small black-powder plant were weighted to include another plant in the same locality, which was not scheduled, but which was operated by the same company and had the same general occupational and wage structure. Fifty-six plants, having a total of approximately 50,700 employees, were studied. Most of these plants specialized in the production of one of the explosives included in the survey, but six were producing two of these products—two manufactured smokeless powder and TNT; two, TNT and dynamite; one, smokeless powder and dynamite; and one, black powder and dynamite. Workers in these six establishments have been classified according to the specific product they were producing at the time of the survey. The wage data presented for the various branches of the industry, therefore, relate to the production of smokeless powder in 10 plants, TNT in 10 plants, dynamite in 29 plants, and black powder in 13 plants. Four of the TNT plants were also producing DNT.

The 56 plants studied were operated by 19 different companies. Three large companies, however, are dominant in the industry. Together, these three companies operated 34 of the 56 plants and employed over 80 percent of the workers studied. All but 4 of the 13 Government-owned smokeless-powder and TNT plants in production at the time of the survey were operated by these 3 companies.

The wage data on which this report is based were collected by experienced field representatives of the Bureau, who visited the plants and transcribed the information from pay rolls and related plant records. The earnings data relate, in most plants, to a typical June 1944 pay-roll period. The occupational wage data represent straight-time average hourly earnings, excluding premium overtime payments and shift differentials.

Detailed occupational wage data are shown for a total of 28,921 workers employed in key occupations selected for study in each branch of the industry. These selected occupations account for well over three-fifths of the plant workers employed in the establishments studied, and are believed to represent adequately the various skill and earnings levels in the industry. In order to obtain maximum comparability among the various establishments studied, standard occupational descriptions were used in classifying all workers in each of the plants studied. The duties performed by workers included within the individual occupations are, therefore, believed to be closely comparable for all plants.

In addition to the occupational wage data, such related items as number of shifts operated, method of wage payment, extent of unionization, entrance rates paid to male common labor, and the policy of the company concerning the payment of overtime and differentials for work on late shifts, were also obtained for each establishment.

The Labor Force

The wartime development of the explosives-manufacturing industry involved the recruitment and training of thousands of inexperienced workers within a very short period of time. Although the black-powder and dynamite plants have expanded somewhat to meet the added demands brought on by the war, the recruitment of new workers for these plants was on a much smaller scale than in the production of smokless powder and TNT. The production of these latter products may, in fact, be considered in the nature of a new industry. Since only a small number of people were trained for work in the manufacture of these products before the war, it was necessary to carry on extensive training on the job as new plants started production. Many of the workers employed by these plants were recruited from rural areas and were entering the industrial labor force for the first time.

CHARACTERISTIC JOBS

Many of the jobs involved in the manufacture of explosives require a considerable degree of skill, detailed knowledge of processes, and much responsibility. In the acid area, for instance, the experienced workers are responsible for certain operating units which, while largely automatic, require careful tending of the dials and gauges which indicate their operation. In the acid area, as in other departments, many of the plants start new workers as helpers, and upgrade them to other jobs in the area after they have learned the operations by observation and have been thoroughly trained to observe safety rules.

Many of the occupations on the smokeless-powder line involve the operation of machines. About 15 percent of the workers studied in this department were employed on the operation of the large presses which are used at various stages in the process for dehydrating, blocking, screening, and graining the powder. These operations entail heavy work and are usually performed by men. Some degree of mechanical ability is necessary for the actual performance of the duties connected with these jobs, but the prime requirement is that the operator be mentally alert and that he be thoroughly familiar with all phases of the particular operation on which he is working. The graining-press operator, for example, operates the machine that produces extruded strands of powder which are later cut into the desired length to form grain powder. His specific duties include loading the blocks of powder into the press, applying the proper amount of pressure to regulate the rate of extrusion, and directing the powder strands into the proper containers. He is also responsible for watching the quality of the powder strands, for checking the dies for proper performance, and for close observation of the pressure gauge. The press and the floor must be kept clean and free of scrap powder at all times.

Another numerically important group of workers consists of the powder-cutting operators. The function of the powder-cutting machine is to cut the extruded strands of powder into specified lengths. The duties of the operators consist of feeding the powder strands into the guide holes of the machine, adjusting the speed of the feed mechanism to cut grains of a specific size, and transferring the cut powder from the fiber containers, into which it falls, to carts or cars. The actual operations of starting and stopping the machine are usually performed by men, while women are employed mainly to feed the strands of powder into the machines. Helpers constituted the largest occupational group on the smokeless-powder line at the time of the survey. These workers are distributed throughout the different operations on the powder-making line. Their duties are varied and include such work as assisting the machine operators, handling the materials needed in the various operations, and assisting with the cleaning of equipment.

Among the more highly skilled workers in the plant are those employed in the various crafts in the maintenance departments. The workers requiring the least amount of skill are those classified in such indirect jobs as janitors, coal handlers, and loaders and unloaders.

WORKING CONDITIONS

Recruitment of a sufficient labor force in explosives plants is hampered somewhat by the inherent hazard of the industry. Extraordinary safety precautions must be observed in the construction and maintenance of the plant. All of the new Government-owned plants and most of the privately owned plants in operation before the war are in isolated areas. The plants cover large tracts of ground and the manufacturing operations are performed in widely separated buildings. The grounds are well fenced and are protected by armed guards.

Careful instruction with regard to safety precautions is, of course, an essential part of the program of training workers for employment in explosives plants. Rigid safety rules are enforced by management and must be observed by each worker for his own safety as well as for that of fellow workers. The number of persons and amount of explosive material allowed in any one building at a given time are generally very strictly limited. Carrying matches into the production areas is always prohibited; shoes with nails are likewise outlawed, and the workers are generally required to wear special "powder" shoes on the production lines. Some housekeeping and clean-up duties are a part of nearly all jobs. As a result of the extreme measures taken by the companies for the protection of workers, the explosives-manufacturing industry has maintained a remarkably low accident-frequency record in spite of heavy production schedules.

All but 8 of the 41 establishments manufacturing black powder and dynamite employed fewer than 250 workers at the time of the survey. Three of the 8 plants with more than 250 workers were dynamite plants that also manufactured either smokeless powder or TNT. Excluding these 3 plants, smokeless powder and TNT were manufactured in 15 additional plants. The smokeless-powder and TNT plants were considerably larger than the dynamite and black-powder plants, as 13 of the 15 were new Government-owned plants. The plant employment for establishments producing these two explosives ranged from about 700 to more than 7,000.

Women constituted about 22 percent of the labor force employed by the 56 plants studied. The employment of women workers varied somewhat among the different branches of the industry. Women are not generally employed in black-powder plants; at the time of the survey, a small number were employed in the occupations studied, by only one plant. In dynamite-manufacturing plants, only about 7 percent of the workers for whom occupational wage data are shown were women. These workers were employed in such light work as that of shell rollers, shell-house helpers, dynamite loaders' and mixers' helpers, routine testers, and dynamite packers. Similarly, in TNT plants, women accounted for less than 7 percent of the workers studied, and were employed only as helpers in the TNT area, as technicians and testers, and as timekeepers, guards, and janitresses. The largest number of women workers in the industry were employed in smokeless-powder plants, where they accounted for well over a fifth of the workers studied. By far the majority of these workers were employed as helpers in the nitrocellulose area and on the powder-making line, although a large number were also employed as powder-cutting operators and as technicians. None of these occupations involve particularly heavy work.

Workers in explosives-manufacturing establishments are not widely organized into labor unions. Although 17 of the plants studied reported union agreements, only about a fifth of the workers were employed by these plants. Seven of these plants had agreements with affiliates of the American Federation of Labor, 5 had agreements with unions affiliated with the Congress of Industrial Organizations, and 5 were operating under agreements with the United Mine Workers of America.

Wage-Payment Practices

Workers employed in the explosives-manufacturing industry are paid almost exclusively on a straight-time basis. The smokeless-powder and TNT plants employed no workers under incentive methods of wage payment, while only about 1 percent of the workers in dynamite and black-powder plants were paid on an incentive basis. The few incentive workers found in the dynamite plants were nearly all machine dynamite loaders; most of those found in the black-powder plants were machine pellet wrappers. Seven plants reported length-of-service bonuses.

Multiple-shift operations were reported by 42 of the 56 plants included in the survey. Of the total number of workers employed by the establishments studied, about a half were working on the first shift, slightly more than a fourth on the second, and slightly less than a fourth on the third. The 14 plants having only one shift were all dynamite and black-powder plants. Most of the workers (76 percent) in these two branches of the industry were, therefore, employed on the first shift, with 15 percent on the second and 9 percent on the third. The distribution of workers by shift was more uniform in smokeless-powder and TNT plants; 46 percent were employed on the first shift, about 28 percent on the second, and 26 percent on the third shift. Twenty plants reported the weekly or biweekly shift rotation of production workers.

Twenty-six of the 42 plants reporting more than one shift in operation also reported the payment of shift differentials. These differentials ranged from 2 to 5 cents an hour over the day-shift rates for the same occupations. All plants reporting the payment of shift differentials paid the same amount for the second and third shifts.

Most of the plants studied were on a 48-hour week schedule. There was very little variation in overtime-payment policies from one plant to another. All of the plants studied paid time and a half for work in excess of 40 hours a week, and all but 4 of the plants also paid this overtime rate for work after 8 hours a day. Work on recognized holidays (in most cases the 6 holidays named by Executive order) was paid for at the rate of time and a half in 52 plants. Double time was paid for work on the seventh consecutive day in 46 plants.

Established entrance rates for male common labor were reported by 48 of the 56 companies. These entrance rates ranged from 50 cents an hour in one plant to 91 cents in another. Thirty-nine plants, however, reported entrance rates for male common labor within the narrower range of from 60 to 80 cents.

Occupational Earnings

Straight-time average hourly earnings for the selected occupations in each branch of the explosives industry are shown, by plant department, in the table on page 14. Because of the small number of plants and companies involved in each branch of the industry it was not feasible to present figures by region. An analysis of the earnings data for plants in different regions, however, indicates that there are no consistent geographical variations in the industry.

SMOKELESS POWDER

The production of smokeless powder constitutes the largest branch of the industry in terms of numbers of workers employed. The average hourly earnings data are for 19,118 workers, employed in 10 plants manufacturing smokeless powder, and classified into 85 selected occupations. Straight-time average earnings of all workers covered in these occupations amounted to 92 cents an hour. The general average for men was 97 cents an hour and for women 72 cents. The lower average for women results from the fact that most of them are employed as helpers and in the lower-paid occupations.

The range in rates was from 64 cents an hour for janitresses to $1.44 an hour for lead burners. The majority of the workers, however, were paid average earnings falling within a much more limited range. Approximately 60 percent were classified in those occupations having average earnings ranging from 75 cents to $1.00 an hour. Average earnings in the interval between 75 and 80 cents an hour accounted for fully a tenth of the workers, while somewhat more than an eighth were in occupations having average earnings of 80 to 85 cents an hour. The greatest concentration of workers occurred in the 19 occupations with earnings between 90 and 95 cents an hour. Nearly a fourth of the workers were employed in these occupations.

In general, the highest earnings for any one department were paid to maintenance workers, who accounted for 18 percent of all workers studied. With the exception of oilers and journeymen's helpers, all workers in the maintenance group were paid hourly rates of well over $1.00 an hour. Working foremen in the processing departments averaged $1.07 an hour. Operators in the processing occupations were paid average earnings ranging from 75 cents an hour for female powder-cutting operators to $1.08 an hour for ether-house operators. Helpers on the powder-making line constituted the largest occupational group, with earnings of 82 cents an hour for men and 72 cents for women. The apparent margin between the earnings of males and those of females within the same occupation actually reflects a difference in duties. The male workers generally perform the heavier work, whereas the women are assigned a number of duties throughout the powder line which do not require the lifting of heavy objects.

Workers in four of the occupations in the acid area, acid-recovery operators, compressor operators, nitric-acid concentrator operators, and sulphuric-acid concentrator operators, were paid $1.00 or more an hour. The acid area employed relatively few workers as compared with those employed in the nitrocellulose area and powder line. Acid helpers, the occupation in which the largest number of workers was classified, earned an average of 83 cents an hour.

Nitrator operators, numerically the most important occupation in the nitrocellulose area, were paid hourly rates averaging 90 cents an hour. The highest average earnings in this area were those of cotton-picker operators and nitrating acid mixers. Both of these small groups earned an average of 99 cents an hour. Male and female helpers had respective average earnings of 79 and 75 cents an hour.

On the powder-making line, employees in only three occupations (activated-carbon operators, ether-house operators, and inert-gas operators), each accounting for a small number of workers, earned average rates of $1.00 or more an hour. Aside from helpers, female powder-cutting operators and male mixer operators formed the largest occupational groups. The respective earnings of these two groups amounted to 75 and 90 cents an hour.

Of the indirect workers other than maintenance craftsmen, the highest hourly earnings were paid to locomotive engineers ($1.26) and to stationary engineers in the powerhouse ($1.24). Truck drivers and power truckers, together accounting for the majority of the material-movement workers, averaged 82 and 85 cents an hour, respectively. Loaders and unloaders averaged only 70 cents an hour. Among the custodial occupations, firemen and male guards averaged 93 cents an hour and the small group of female guards, 71 cents.

TNT AND DNT

Earnings data for TNT and DNT are shown in the table for 10 plants, four of which were producing DNT at the time of the survey, and cover 6,492 workers in 66 selected occupations. For this branch of the explosives industry as a whole, the workers studied were paid, on the average, $1.01 an hour; the hourly average for all male workers studied amounted to $1.02, or 22 cents more than the average for women, who were employed only in indirect jobs and as helpers in the TNT area. It will be noted that these general averages for TNT plants are somewhat higher than those for the smokeless-powder plants. This difference is due partly to the fact that larger proportions of the workers in smokeless-powder plants are employed as helpers. Furthermore, workers in the TNT and DNT area are paid higher average hourly earnings than workers in most occupations found in either the nitrocellulose area or on the smokeless-powder line.

The average hourly earnings for individual occupations in the TNT plants studied ranged from 61 cents for janitresses to $1.39 for class A millwrights. Fully a half of the workers, however, were employed in occupations having average earnings which ranged from 90 cents to $1.15 an hour. Roughly an eighth of the workers were in occupations with average earnings ranging from 90 to 95 cents, and nearly a fifth in occupations averaging from $1.10 to $1.15 an hour.

The maintenance workers are paid higher average hourly earnings, on the whole, than workers in any other single department. Oilers, earning 91 cents an hour, and journeymen's helpers, earning 84 cents an hour, were the only maintenance workers not having average earnings of well over $1.00. Class A maintenance mechanics, comprising the largest group of workers in the department, earned an average hourly rate of $1.34. A comparison of the earnings of workers in those maintenance occupations found in both the smokeless-powder and TNT branches of the industry reveals that although workers in TNT plants are paid higher average rates in a number of occupations, this advantage is not consistent. Moreover, the difference in the average earnings per hour amounts to only 5 cents or less in all but 4 of the occupations.

Average hourly earnings of working foremen in the processing departments amounted to $1.14 an hour. Workers in three processing occupations, bi-tri operators, DNT nitrator operators, and fortifier operators, earned an average of $1.11 an hour, the highest average shown for processing operators. The lowest average for processing operators (96 cents an hour) was earned by DNT sweat-house operators and pumpmen in the acid area.

Workers in all but three of the occupations in the acid area, helpers, pumpmen, and sellite-mix men, had average earnings in excess of $1.00 an hour. The earnings of these workers amounted to 93, 96, and 98 cents an hour, respectively. Similarly, the only occupational groups earning an average of less than $1.00 an hour in the TNT and DNT area were DNT sweat-house operators and helpers. The average earnings of male helpers amounted to 86 cents an hour, and those of female helpers to 88 cents. Female helpers were employed in only four plants.

Male guards, who constituted a numerically important group among the custodial occupations, averaged 84 cents an hour. Earnings of material-movement workers varied from an average of 77 cents an hour for loaders and unloaders to $1.19 for yard conductors. The highest-paid workers in the powerhouse were stationary engineers, with average earnings of $1.35 an hour. Workers employed as packers of DNT and TNT earned 93 cents an hour.

BLACK POWDER

Detailed earnings data were obtained for 431 workers engaged in the production of black powder, the smallest branch of the industry included in the study. These workers, employed in 13 plants, were classified into 37 selected occupations. As mentioned earlier, women were employed in these occupations in only one plant; earnings data for women workers are, therefore, not shown.

For the 431 male workers as a group, average earnings amounted to $1.00 an hour. The average hourly earnings for individual occupations ranged from 76 cents for watchmen to $1.32 for class A machinists. Three-tenths of the workers were concentrated in those occupations in which hourly earnings ranged from 90 cents to $1.00, and four-tenths in those averaging between $1.00 and $1.15 an hour.

Among the processing occupations, wheel-mill operators, hydraulic-press operators, and pellet-press operators constituted the most important groups in terms of numbers of workers. Earnings for these three groups averaged $1.11, $1.15, and $1.04, respectively. Working foremen were paid an average of $1.12 an hour. Watchmen, whose average hourly earnings amounted to 76 cents, were the only workers paid less than an average of 80 cents an hour.

DYNAMITE

Altogether, 2,880 workers, employed in 29 plants, were classified in the 65 occupational groups selected for study in the dynamite branch of the explosives industry. As a whole, these workers earned an average of $1.08 an hour. The general average for all male workers studied amounted to $1.09 an hour, while that for the 191 women workers was 89 cents an hour. Women were generally employed only as helpers or in light work.

Straight-Time Average Hourly Earnings of Workers in Selected Occupations of the Explosives Industry, June 1944

SMOKELESS-POWDER BRANCH

Occupation	Number of workers	Average hourly earnings
Maintenance		
Blacksmiths	15	$1.27
Carpenters, class A	415	1.21
Carpenters, class B	86	1.04
Electricians, class A	207	1.32
Electricians, class B	45	1.13
Helpers, journeymen, male	305	.91
Helpers, journeymen, female	18	.75
Instrument repairmen	64	1.25
Lead burners	28	1.44
Machinists, class A	132	1.32
Machinists, class B	32	1.14
Mechanics, automotive	192	1.13
Mechanics, maintenance, class A	302	1.30
Mechanics, maintenance, class B	304	1.12
Millwrights, class A	365	1.31
Millwrights, class B	107	1.13
Oilers	60	.91
Painters	93	1.11
Pipefitters, class A	335	1.33
Pipefitters, class B	83	1.15
Scale repairmen	32	1.15
Sheet-metal workers, class A	70	1.30
Sheet-metal workers, class B	21	1.08
Tool and die makers, class A	21	1.26
Welders, hand	90	1.27
Supervision		
Working foremen, processing departments	1,167	1.07
Processing		
Acid area:		
Acid-recovery operators	26	1.03
Ammonia-oxidation operators	45	.99
Compressor operators	29	1.01
Helpers, acid area	172	.83
Mixed-acid operators	58	.97
Nitric-acid concentrator operators	50	1.00
Oleum-plant operators	18	.95
Pumpmen	33	.93
Sulphuric-acid concentrator operators	36	1.00
Waste-water operators	11	.82
Nitrocellulose area:		
Beater operators	46	.95
Blenders, nitrocellulose	79	.89
Boiling-tub operators	107	.92
Cotton dry and weigh operators	174	.84
Cotton-picker operators	57	.99
Cotton-wringer operators	500	.93
Helpers, nitrocellulose area:		
Male	568	.79
Female	530	.75
Nitrating acid mixers	72	.99
Nitrator operators	681	.90
Poacher operators	90	.92
Powder-making line:		
Activated carbon operators	46	1.00
Air-dry operators	84	.91
Blender operators, smokeless powder	162	.99
Block-press operators	288	.88
Processing—Continued		
Powder-making line—Continued.		
Chemical-preparation operators	20	$0.96
Coating-house operators	41	.97
Dehydrating-press operators	267	.95
Ether-house operators	41	1.08
Ether-mix operators	15	.97
Glazing operators	43	.93
Graining-press operators	363	.94
Helpers, powder-making line:		
Male	1,863	.82
Female	2,153	.72
Inert-gas operators	10	1.04
Macaroni-press operators	250	.95
Mixer operators, smokeless-powder	721	.90
Powder-cutting operators:		
Male	170	.93
Female	952	.75
Screen and pack operators	239	.97
Solvent-recovery men	165	.95
Water-dry operators	65	.91
Inspection and testing		
Routine testers, laboratory	31	.91
Technicians, male	131	.91
Technicians, female	315	.70
Packing		
Packers, smokeless powder	115	.91
Powerhouse		
Coal handlers	72	.72
Engineers, stationary	58	1.24
Firemen, stationary boiler	56	1.17
Water tenders	29	.94
Recording and control		
Magazine keepers	44	.88
Stock clerks	89	.95
Stock men	37	.88
Timekeepers	36	.84
Tool clerks	14	.89
Material movement		
Brakemen, yard	28	1.05
Conductors, yard	23	1.17
Engineers, locomotive	30	1.26
Loaders and unloaders	149	.70
Truck drivers	307	.82
Truckers, power	244	.85
Custodial		
Firemen, plant protection	143	.93
Guards, male	771	.93
Guards, female	48	.71
Janitors	304	.71
Janitresses	115	.64

Straight-Time Average Hourly Earnings of Workers in Selected Occupations of the Explosives Industry, June 1944—Continued

TNT-DNT BRANCH

Occupation	Number of workers	Average hourly earnings
Maintenance		
Blacksmiths	6	$1.18
Carpenters, class A	119	1.26
Carpenters, class B	21	1.09
Electricians, class A	97	1.36
Electricians, class B	19	1.14
Helpers, journeymen	87	.84
Instrument repairmen	33	1.29
Lead burners	39	1.37
Machinists, class A	41	1.33
Machinists, class B	22	1.14
Mechanics, automotive	92	1.17
Mechanics, maintenance, class A	180	1.34
Mechanics, maintenance, class B	34	1.10
Millwrights, class A	88	1.39
Millwrights, class B	31	1.15
Oilers	28	.91
Painters	44	1.11
Pipefitters, class A	141	1.34
Pipefitters, class B	82	1.13
Scale repairmen	8	1.18
Sheet-metal workers, class A	18	1.32
Welders, hand	42	1.26
Supervision		
Working foremen, processing departments	189	1.14
Processing		
Acid area:		
Acid recovery operators	173	1.07
Ammonia-oxidation operators	74	1.08
Compressor operators	32	1.10
Helpers, acid area	87	.93
Mixed-acid operators	50	1.08
Nitric-acid concentrator operators	52	1.06
Oleum-plant operators	25	1.04
Pumpmen	139	.96
Sellite-mix men	39	.98
Sulphuric-acid concentrator operators	62	1.07
Waste-water operators	34	1.06
TNT and DNT area:		
Bi-tri operators	400	1.11
DNT-nitrator operators	16	1.11
Fortifier operators	161	1.11
Grainers, TNT	49	1.05
Helpers, TNT and DNT:		
Male	331	.86
Female	109	.88
Mono-nitrator operators	211	1.10
Processing—Continued		
TNT and DNT area—Continued.		
Sweat-house operators, DNT	36	$0.96
Wash-house men	273	1.03
Inspection and testing		
Routine testers, laboratory:		
Male	25	.91
Female	227	.79
Technicians:		
Male	31	1.03
Female	23	.90
Packing		
Packers, DNT and TNT	397	.93
Powerhouse		
Coal handlers	39	.78
Coal pulverizer operators	10	1.00
Engineers, stationary	28	1.35
Firemen, stationary boiler	33	1.07
Generator-switchboard operators	26	1.18
Water tenders	13	1.03
Recording and control		
Magazine keepers	27	1.04
Stock clerks	52	.94
Stock men	21	.89
Timekeepers, male	19	.97
Timekeepers, female	4	.73
Tool clerks	8	.77
Material movement		
Brakemen, yard	68	1.09
Conductors, yard	46	1.19
Engineers, locomotive	76	1.18
Loaders and unloaders	440	.77
Truck drivers	211	.92
Truckers, hand	30	.84
Custodial		
Change-house men	16	.66
Firemen, plant protection	112	.86
Guards, male	468	.84
Guards, female	31	.72
Janitors	173	.67
Janitresses	24	.61

BLACK-POWDER BRANCH

Occupation	Number of workers	Average hourly earnings
Maintenance		
Carpenters, class A	13	$1.23
Carpenters, class B	5	.91
Electricians, class A	3	1.07
Machinists, class A	4	1.32
Mechanics, maintenance, class A	5	1.15
Mechanics, maintenance, class B	7	.95
Supervision		
Working foremen, processing departments	7	1.12
Processing		
Powder making:		
Dry-house operators, soda	9	$0.93
Mixer operators, black-powder	4	.92
Pulverizer operators	15	1.01
Wheel-mill operators	36	1.11
Wheel-mill helpers	9	.87
Grain line:		
Dry-house operators	5	.88
Glazing operators	18	1.11
Glazing helpers	5	.84
Graining operators	16	1.06

***Straight-Time Average Hourly Earnings of Workers in Selected Occupations of the Explosives Industry, June 1944*—Continued**

BLACK-POWDER BRANCH—Continued

Occupation	Number of workers	Average hourly earnings
Processing—Continued		
Grain line—Continued.		
Hydraulic press operators	30	$1.15
Screen and pack operators, black-powder	16	1.03
Screen and pack helpers, black-powder	8	.97
Pellet line:		
Blackstick-crimp operators	4	.90
Dry-house operators	7	1.04
Packers, pellet	23	.99
Pellet-press operators	29	1.04
Pellet-press helpers	10	.92
Pellet wrappers, hand	4	1.09
Pellet wrappers, machine	17	.99
Screen operators	11	1.04
Inspection and testing		
Routine testers, laboratory	3	1.10
Powerhouse		
Engineers, stationary	10	$0.97
Firemen, stationary boiler	21	.91
Recording and control		
Magazine keepers	6	1.11
Material movement		
Loaders and unloaders	11	.83
Truck drivers	17	.86
Truckers, hand	7	.92
Truckers, power	4	.90
Custodial		
Guards	15	.87
Watchmen	17	.76

DYNAMITE BRANCH

Occupation	Number of workers	Average hourly earnings
Maintenance		
Blacksmiths	9	$1.19
Carpenters, class A	71	1.33
Carpenters, class B	29	1.13
Electricians, class A	25	1.31
Electricians, class B	8	1.13
Helpers, journeymen	57	.99
Lead burners	15	1.32
Machinists, class A	40	1.35
Machinists, class B	9	1.11
Mechanics, automotive	16	1.28
Mechanics, maintenance, class A	35	1.26
Mechanics, maintenance, class B	34	1.05
Millwrights, class A	17	1.46
Painters	26	1.17
Pipefitters, class A	39	1.40
Pipefitters, class B	16	1.12
Scale repairmen	3	1.39
Welders, hand	11	1.36
Supervision		
Working foremen, processing departments	143	1.25
Processing		
Acid area:		
Acid-recovery operators	22	1.05
Ammonia-oxidation operators	40	1.27
Helpers, acid area	47	.90
Mixed-acid operators	16	1.26
Nitrate of ammonia operators	85	1.15
Nitric-acid concentrator operators	24	1.28
Nitric-house operators	14	1.26
Pumpmen	6	1.07
Sulphuric-acid concentrator operators	14	1.15
Sulphuric-acid operators	19	1.23
Nitroglycerin line:		
Nitroglycerin helpers	15	.93
Nitroglycerin-neutralizer operators	27	1.19
Nitroglycerin-nitrator operators	32	1.23
Nitroglycerin-separator operators	28	1.23
Dope house:		
Dope-dryer operators	26	1.04
Dope dry-house operators	37	1.07
Dope-grinder operators	18	1.05
Dope-house helpers	44	.88
Dope mixers	24	1.15
Processing—Continued		
Shell house:		
Shell dippers	14	$1.02
Shell-house operators	35	1.08
Shell-house helpers, male	46	.89
Shell-house helpers, female	39	.81
Shell rollers, hand, male	8	.95
Shell rollers, hand, female	36	.79
Powder line:		
Dynamite loaders, hand	38	1.00
Dynamite loaders, machine	175	1.18
Dynamite loaders, helpers, male	118	.96
Dynamite loaders, helpers, female	11	.94
Dynamite mixers	93	1.15
Dynamite mixers, helpers, male	43	.98
Dynamite mixers, helpers, female	7	.87
Inspection and testing		
Routine testers, laboratory, female	14	.80
Technicians	10	1.13
Packing		
Packers, dynamite, male	197	1.02
Packers, dynamite, female	74	1.00
Powerhouse		
Coal handlers	5	.80
Engineers, stationary	58	1.22
Firemen, stationary boiler	67	.98
Recording and control		
Magazine keepers	29	1.06
Stock clerks	3	.93
Material movement		
Brakemen, yard	17	1.03
Engineers, locomotive	44	1.11
Loaders and unloaders	88	.99
Truck drivers	62	.97
Truckers, hand	99	.96
Truckers, power	16	.92
Custodial		
Change-house men	13	.99
Guards	178	1.01
Janitors	36	.99
Janitresses	10	.84
Watchmen	56	.76

As in the other three branches of the industry, the range in average hourly earnings between the lowest- and the highest-paid occupations was very wide, amounting in this case to 70 cents. Watchmen, the lowest-paid occupational group, earned 76 cents an hour; class A millwrights earned $1.46 an hour, the highest average shown for any occupation. Nearly two-thirds of the workers studied were employed in occupations whose earnings ranged from 95 cents to $1.20 an hour. A fifth of the workers were employed in the 10 occupations having earnings within the range of from 95 cents to $1.00 an hour, and another fifth were concentrated in the 6 occupations with earnings averaging from $1.00 to $1.05 an hour. Well over a fifth of all the workers were classified in occupational groups with average hourly earnings in excess of $1.20 an hour.

In the maintenance department, class A carpenters constituted the largest occupational group, and were paid, on the average, $1.33 an hour. Class A machinists, maintenance mechanics, and pipefitters had respective average earnings of $1.35, $1.26, and $1.40 an hour. Journeymen's helpers earned an average of 99 cents an hour.

In general, the highest earnings among the processing departments were paid to workers in the acid area and the nitroglycerin line. With the exception of helpers, acid-recovery operators received the lowest average rate ($1.05 an hour). Nitrate of ammonia operators, the largest occupational group in the acid area, averaged $1.15 an hour. Dope dry-house operators and shell-house operators had respective averages of $1.07 and $1.08 an hour. Machine dynamite loaders, accounting for the largest number of workers in the processing departments, earned $1.18 an hour. Working foremen averaged $1.25.

The occupation of dynamite packer included both men and women, and accounted for a large number of workers. The average for men amounted to $1.02, and that for women to $1.00, an hour.

The average hourly earnings for material-movement employees ranged from 92 cents for power truckers to $1.11 for locomotive engineers. Among the custodial jobs, the guards, who earned an hourly average of $1.01, formed the largest group of workers. Janitors averaged 99 cents and watchmen 76 cents an hour.

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