curately controlling time, temperatures and pressures. Sufficient mercury thermometers as well as recording thermometers are correctly placed and constantly checked to assure the maintenance of correct temperatures.

Each of these processing operations requires unusual care, extreme accuracy combined with adequate supervision and inspection to assure quality and safety of the product.

In spite of the utmost care, defects in workmanship and materials do occur in any manufactured article. These defects must be found before the article leaves the factory, therefore, it is necessary to minutely inspect each article, diligently searching for and rejecting defective merchandise. These inspectors, well trained, are paid a bonus for finding defects; however, as an added precaution, their workmanship in turn is checked by product quality inspectors to assure accuracy and efficiency.

The modern tire is only one important accessory for the car of today. The same painstaking care in manufacture, the same high regard for quality, the same precautions to assure the consumers' safety is a major part of every piece of equipment that is manufactured into each car. Tires are safe and automobiles are safe—if the person behind the wheel and in control cooperates by thinking and driving safely.

Quality control work in any manufacturing industry involves two major safety functions. The first consideration is the safety of the employee, to see that the operator is performing his job with the maximum degree of safety to himself, that the materials he works with, his tools or machines have no apparent functional defects that may be hazardous to safety. The second consideration, safeguarding the safety of the consumer by seeing that each operation is being performed correctly, being constantly alert to insure the observance of specifications in order that uniformly high quality, safe merchandise is produced.

Dusts in the Rubber Industry

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Dusts may be classified in two main groups:

1. Harmful: 2. Not harmful or nuisance.

When we think of this classification, we undoubtedly think of some type of pneumonoconiosis. However, I believe we must not base our conception of dusts on this basis, but assume that all dusts are detrimental to the human system as a whole when the concentrations are high enough. Whether the disability is due to a toxic condition or to a mechanical one, of course, depends entirely upon the nature of the dust. The conditions usually referred to as being of mechanical origin fall under that condition known as pneumonoconiosis with its various sub-divisions of:

1. Silicosis.
2. Siderosis.
3. Anthracosis.
4. Asbestosis.
5. Chalcosis.
6. Chalicosis.

The method of contracting pneumonoconiosis is by inhalation of the dust; however, all dusts do not cause pneumonoconiosis. The higher the silica content of a dust the greater the possibility of developing a fibrosis and the higher the percentage of crystal content the greater the irritation. The diagnosis of the type of pneumonoconiosis is based upon the following:

1. Past history and occupation.
2. Physical examination.
3. Clinical examination of sputum.
4. X-rays of lungs.

Since we have been studying the lungs of industrial workers by x-rays, there has developed an entity which should be termed the "Industrial Lung." This condition, I believe, should not be termed a pneumonoconiosis because it reaches a certain stage, does not progress any further and after several months to a year improves. There are no symptoms nor decreased capacity of the lungs. It is discovered only by a series of x-rays taken over a period of years.

The other conditions caused by inhalations of soluble dusts, insoluble, but free from silica, and metallic dusts have to be discussed under a specific condition; for example, lead poisoning is very frequently caused by the inhalation of lead dust; and many nose and throat irritations are caused by inhalation of insoluble dusts whose action is strictly mechanical. We therefore may also classify dusts as: 1. Pneumonoconiotic; 2. Non-pneumonoconiotic.

Some of the principal dusts or materials used in industry which fall under these classifications are as follows:

Pneumonoconiotic:

1. Silicosis (sandstone, slate flour, fuller's earth, Stoughton earth, infusional earth, rotten stone, any other clay with more than ½ of 1% silica, ground glass).
2. Siderosis—iron ores, iron oxides (nat.), iron sulphides (nat.).
3. Anthracosis—coal and carbon dusts.
4. Asbestosis—powdered asbestos, asbestos ore.
5. Chalcosis—copper ore and copper dusts.
6. Chalicosis—stone dusts.

Non-Pneumonoconiotic
Harmful:

1. Lead dusts.
2. Arsenic dusts.
3. Chromium dusts.
4. Cadmium dusts.
5. Antimony dusts.
6. Radium compounds.
7. Alkali dusts.
8. Sulphur dusts.
9. Tellurium compounds.
10. Various colored compounds such as ultra marine blue, Prussian blue, lead chromate, etc.

Non-harmful but nuisance dusts:

1. Soapstone with ½% or less of free silica.
2. Zinc oxide and sulphide.
3. Barium sulphate.
4. Plaster of Paris.
5. Paris white—whiting.
6. Talc.
7. Mica—may cause a mechanical irritation.
8. Oxide of magnesia.
9. Titanium dioxide.

As we can see by this classification we necessarily must go back to our original classification of harmful, and not harmful; and I am convinced that while silicosis is one of our predominant conditions due to silica, there are many other conditions which are produced in the respiratory tract which are harmful to the individual.

The following are the most important materials used in the rubber industry which are in the form of a dust or powder and to which the individual is exposed. They are marked by the following letters—H. harmful; NH, not harmful; HT, harmful and toxic; HP, harmful and pneumonoconiotic; NHN, not harmful but a nuisance dust.

1. Talc soapstone with ½ of 1% or less SiO_2—NHN.
2. Starch and potato flour—NHN.
3. Zinc oxide—NHN—see chest x-ray.
4. Lead oxide, metallic lead dusts, lead chromate, and the various powdered lead compounds—HT.
5. Carbon black—NHN.
6. Rubber dust—finely divided dust from buffing process—NHN.
7. Sulphur—H, sometimes irritates nose and throat and occasionally produces a dermatitis.
8. Whiting—NH.
9. Barytes—NH.
10. Asbestine—HP.
11. MgO, and $MgCO_3$—NH.
12. Lithopone—NHN.
13. Red lead—HT.
14. High grade clay—HP if over ½ of 1% silica and dust count is over 5,000,000.
15. Corn starch—NHN.
16. English vermilion—HT.
17. Graphite—NHN.
18. Chromium oxide—HT.
19. Ultramarine blue—HT.
20. Titanox—NT.
21. Thermatonic blue—NTN.
22. Zinc stearate—NHN.
23. Aluminum—NHN, occasionally causes a mechanical dermatitis and irritation of mucous membranes of nose and throat.
24. Hard rubber dust—NHN.
25. Lime—H caustic. Produces dermatitis.
26. Various alkali dusts—H caustic.
27. Various chromium and cadmium dusts—HT.
28. Mica — NH — sometimes causes mechanical dermatitis.
29. Yellow oxide (Fe_2O_3), NHN.
30. Black oxide (Fe_3O_4), NHN.
31. Gypsum—NHN.
32. Casein—NH.
33. Wood flour—NH.
34. Prussian blue—HT.

35. Soap powder — irritant NH. Sometimes causes dermatitis.
36. Captax—NH.
37. Phenyl—Beta Napthylame—HT, causes a dermatitis.
38. Soap bark—NH, sometimes causes a little coryza and conjunctivitis.
39. Cotton lint dust—NHN.
40. Bronze powder—HT—ac to copper and lead content.
41. Zinc sulphide—NHN.
42. Sand—HP.
43. Various clays having more than ½ of 1% of free silica—HP.
44. Antimony oxide—HT.
45. Titanium oxide—NH.
46. Various inorganic and organic chemical compounds in powdered form often produce dusts during their use and manufacturing. These must be considered individually as to their industrial hazard and toxicity and are not in the scope of this paper.
47. Wheat and potato flour—NHN.

The following procedure will be helpful in solving your problem of dust.

1. Make repeated dust counts of the working area at various levels.
2. Obtain some of the dust and send it to the laboratory for complete analysis including the determination of free SiO_2.
3. Examine the workers, x-rays of the chest for those working in pneumonoconiotic dusts.
4. Check the ventilation and increase it to produce non-hazardous atmospheres.
5. Differentiate between conditions caused by volatile substances and solvents, and those caused by dusts.
6. Protect the workers with proper clothing and protective respirators and masks.
7. Study the particular dusts from the mechanical and chemical nature and if the effects are unknown, resort to animal experimentation.
8. If dusts are toxic and harmful consider the possibility of a substitution for a nonharmful substance.
9. Examine and x-ray all employees who are being placed on jobs where there is a dust hazard. They should be examined periodically.
10. Make each dust problem an individual one, and in case of silicotic dusts, keep the counts below 5 M. per cu. ft., if the free SiO_2 is more than 1%.
11. Select employees free from TB, chronic bronchitis, post influenzal infections, post pneumonic conditions, asthmatics, and persons with myocardial involvements for dusty operations.

I have found that there is x-ray evidence of tuberculosis in about 2 per cent of the cases but only ½ of 1 per cent active and of a permanent disability. Uncomplicated pneumonoconiosis of a moderate degree is not disabling to a point of permanent disability.

I want to present to you a case which I think is a rare one. This employee has never worked in any dust before his employment on his present job. He has worked for 12¼ years in zinc oxide dust and during our periodic examinations in 1938 the x-ray picture proved very interesting. He does not have a definite pneumonoconiosis but he shows evidence of glandular fibrosis. What will develop in a few more years will be shown by x-ray examination only. He has no symptoms. If this man had been working in lead or similar toxic dusts, symptoms of that particular substance would have been present.

The dust counts on toxic dusts must be kept at a minimum, and much lower than that for silicotic dusts. In silicotic dusts the particles of 10 micron size or larger are of very little concern, but with toxic dusts the size of the particles is not so important as is the number of particles. The smaller the particles of dust the less the rate of settling and the greater the time of exposure, and this is the important item in toxic dusts. For example, the permissible amount of lead dust is approximately 15 mgs. per day of eight hours. There would be very little chance of any one ever developing a pneumonoconiotic condition with this dust count, but if it is increased very little there is a chance for lead poisoning, and so it is with the various toxic dusts.

The question in most of your minds is, "What are you going to do about these conditions?" The answer is simple. You are going to correct them. It has been proved many times that it pays big financial returns, creates better working conditions, and the employees have a more efficient and appreciative attitude for the employer.

It is unnecessary for me to consider the methods of correcting the dust problems for this is in the realm of the ventilation engineer, but you must insist that the ventilation be sufficient to reduce the dust count to a certain point and have it maintained at that point.

You should periodically examine your employees according to the type of dusts exposed to and as a suggestion the following is a schedule which I have used for a few years.

Silicosis or silicotic dusts—six months including x-rays.

Non-silicious and non-silicotic or nontoxic dusts—every year, with x-rays.

Toxic dusts—for example lead, chromium, arsenic, antimony, phosphorus, chemical dusts, and alkali and caustic dusts—every month.

Nuisance dusts—every 1 to 1½ years—x-rays only if indicated.

If you find any evidence of trouble it is better to correct the cause than to transfer the employee elsewhere, for this often causes dissatisfaction and suspicion. All such conditions can be controlled if there is cooperation between the medical, engineering and managing departments. In most states at present all conditions caused by dust are compensable, so it behooves the employer to correct his working conditions to a point at which there are no hazards.

Conclusion

It is impossible to give a detailed description of all the dusts used in the rubber industry, for the silicotic dusts alone would require a volume to do them justice, but I want you to remember that there are just as many serious conditions which may develop from the inhalation of various toxic dusts.

These conditions are often more serious than pneumonoconiosis and develop much faster and in a shorter period of time. For instance, a person may develop a lead poisoning in two months from inhalation of lead compounds and it might take five to ten years for a silicosis to develop in the same environment of silica dust.

There are on the market today many fine and efficient protective devices such as chemical protective masks, dust respirators, positive pressure masks, clothing and gloves which if used will give good results.

Instruction to the employees by the supervision in regard to their personal habits, their instruction concerning the type of dust they are exposed to, and why they have to use the protective appliances, will reduce the possibility of any trouble to a minimum.

All laboratory work must be done by a technician who has been trained in the various toxicological laboratory techniques and the interpretations must be made in conjunction with the past history of the individual. May I say in conclusion that it is much more profitable to correct a dusty operation than to declare it a hazard.

Training Supervision in Accident Prevention

By JOHN J. LOGE

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As we scan the history of the safety movement, we find that a great deal of emphasis has been placed on the foreman's responsibility in accident prevention work. Authorities seem to agree that foremen (and by foremen is meant direct supervision) are very largely responsible for the prevention of accidents in industry.

How do these authorities arrive at their conclusions? Why must the foremen assume the responsibility for injuries to persons under their supervision?

When we tell our supervisors that they must accept the responsibility for accidents occurring in their departments, we must be prepared to state a few reasons. We ask a foreman for a report following an accident, and he has a right to a clear understanding as to the reason why he is called upon to explain when one of his workers is injured. There is nothing mysterious about the placing of responsibility for accidents. It isn't the case of management imposing a burden upon supervision that should belong elsewhere.

As soon as a person is placed in a supervisory capacity, a position where he has charge of the work of others, he becomes directly responsible for their conduct and