age" made from hogs' offal, with 1 pound of 16 per cent superphosphate (acid phosphate) to every 3 pounds of the tankage, dries in midsummer without becoming offensive. In the test, the mixture was spread out in a shallow box and raked over frequently. Four weeks after mixing it was in condition for grinding and bagging. The product contained 2.8 per cent of ammonia and 7.6 per cent of available phosphoric acid (P_2O_5).

In preserving raw offal or blood with acid phosphate, it is advisable to use more of the preservative (about 4 pounds for every 10 pounds of the hashed offal or blood) and to include some nonalkaline absorbent material, such as dry chaff, peat, or gypsum, to keep the compost from becoming fluid. By insuring a sufficiently high acidity, putrefaction and the breeding of flies may be avoided.

This composting process may also prove useful in rural districts for converting other perishable refuse into material that can be stored and used as fertilizer.

G. P. WALTON.

FERTILIZER'S Utility Much Affected by Its Mechanical Condition

The production of fertilizers in this country at present amounts to about 7,500,000 tons annually. The materials used in their manufacture are of varied composition and come from many different sources, but all may be grouped into two classes according as their origin is mineral or organic. The most widely used mineral fertilizers are superphosphate (acid phosphate), nitrate of soda, sulphate of ammonia, and the potash salts. The best-known organic fertilizers are cottonseed meal, dried blood, tankage, and fish scrap. These materials are similar to barnyard manure, in that they are insoluble or only slightly soluble in water and undergo little or no change in physical properties when exposed to damp or humid conditions. The mineral fertilizer materials on the other hand, are all more or less soluble in water and many cake or become sticky when exposed to moisture or a humid atmosphere. This condition is a serious disadvantage to their use in fertilizers, as it greatly interferes with their distribution in the field.

According to the most commonly expressed view, the burning effect of fertilizers is due to the soluble materials which they contain. If their distribution is irregular, as necessarily occurs when they are sticky or caked, the quantity applied in the neighborhood of certain seeds may be sufficient to delay or prevent germination, while others may be insufficiently fertilized for best results. The response which a crop makes to a fertilizer is thus not only dependent on the composition of the fertilizer, but also on its mechanical condition and the uniformity of its distribution in the field.

The organic ammoniates used in fertilizers are all obtained as industrial by-products, and the supply can therefore not be increased independently of the principal products. This restricted production and the competition of the feeding industry have greatly limited the available supply, so that the quantity used in fertilizers has decreased and is likely to continue to decrease from year to year. As a means of maintaining the nitrogen supply, a great deal of attention is now being given to the production of fixed-nitrogen products, materials which contain nitrogen that has been fixed from the air. The fixed-nitrogen materials, however, are readily soluble in water, and in

this way they differ from the organic ammoniates which they are intended to replace. This tendency towards the greater use of soluble materials in fertilizers will increase the difficulty of their handling and distribution unless corresponding improvement is made in their drillability and storage qualities. The question of the mechanical condition of fertilizers is thus becoming a problem of increasing importance in their manufacture.

Caking of Fertilizers

The cause of caking in fertilizers may be very different in different materials, but it is usually associated with the presence of moisture. All soluble materials have the property of taking up moisture from the air when the relative atmospheric humidity exceeds a definite value. Some soluble materials, however, do not take up moisture at ordinary humidities, and thus they remain dry. Other materials absorb moisture from the atmosphere at ordinary humidities, and are said to be hygroscopic. It thus happens that a material or mixture of materials may become moist and cake even when stored in a perfectly dry condition.

The presence of moisture may induce caking (1) by causing the material to "set," as in plaster of Paris, (2) by forming a sticky liquid layer over the surface of each soluble particle, and (3) by causing the separate crystal particles to grow together into a solid mass.

The rate at which all these changes take place in any given material increases with the fineness of grinding. Fine grinding has an additional effect on the mechanical condition of a fertilizer, in that very fine particles cling to each other. A finely divided material therefore has the property of bridging over a small opening, so that its flow through a fertilizer drill is less uniform than one in which the particles are of larger dimensions.

Improving the Condition of Fertilizers

The best known example of "setting" in a fertilizer is that of superphosphate. When the setting is complete no further action takes place and the original mechanical condition of the material may be restored by grinding. This treatment, however, has no permanent effect in improving the mechanical condition of materials which cake for any of the other reasons mentioned. The most effective treatment in such cases will depend on the cause of caking and may consist in (1) reducing the hygroscopic properties of a material by chemical treatment, (2) mixing with insoluble materials, and (3) preparing the product in the form of uniform-sized grains, which thus eliminates the form of caking due to the presence of fine particles.

A number of inorganic materials, such as ordinary and triple superphosphate, which are slightly soluble in water, show little tendency to cake in a pure state but may become sticky and difficult to handle because of the presence of hygroscopic impurities, such as free phosphoric acid. Such impurities are now being rendered inactive by new methods of manufacture and by neutralizing the free acid with lime or by other treatment. The improvement which has been made in the mechanical condition of phosphate materials has compensated in a large measure for the decreased supply of organic conditioners

and is one of the important developments which has recently taken place in the fertilizer industry.

Certain of the fixed-nitrogen products which contain nitrogen as the only fertilizer constituent are the most hygroscopic materials known, and any treatment for their improvement must be applied to the whole product. This improvement may be most successfully accomplished by causing them, in the process of their manufacture, to combine with certain other fertilizer products to form fertilizer materials which contain two plant-food elements, such as phosphate of ammonia and nitrate of potash. These materials are all of good mechanical condition and are among the least hygroscopic of soluble materials.

Soluble materials which show little tendency to absorb moisture from the air are usually in good mechanical condition, but many frequently cake, owing to the characteristic property of their individual particles to stick together. Caking of such materials may be easily and permanently prevented by mixing with a powdered insoluble material such as peat or cottonseed meal. The finely divided particles of insoluble material adhere to and form a coating over the more sticky surfaces of the soluble particles. This coating largely eliminates the sticking properties of the mixture and its mechanical condition is thereby greatly improved. The use of the organic ammoniates as conditioners in fertilizer manufacture is a practice of long standing in the fertilizer industry.

Fertilizers which contain two plant-food elements contain a higher proportion of plant food than equivalent mixtures of single constituent materials. Their bulk per unit of plant food is therefore less than for corresponding mixtures of lower grade materials, and the quantity of an organic ammoniate needed to give the same conditioning effect will likewise be correspondingly less. The fixation of nitrogen in the form of two fertilizer constituent materials thus affords a means of conserving the organic ammoniates required as conditioners in fertilizer manufacture. If present theories are correct, danger from burning, when these high-grade materials are used, will also be decreased in proportion as their content of soluble materials per unit of plant food is less than in mixtures of low-grade materials.

WILLIAM H. ROSS and
ALBERT R. MERZ.

FIRE Loss on Farms $150,000,000 Property and 3,500 Lives a Year It has been estimated that farm fires in the United States annually take a toll of 3,500 lives and cause a property loss of $150,000,000, as compared with an estimated yearly loss of 15,000 lives and $570,000,000 in cities and urban districts.

With fire-loss statistics of the National Board of Fire Underwriters as a basis, it can be computed that the annual increase in property loss from rural fires is about three times as great proportionately as that from urban fires. In considering this increase, attention should be given to the fact that the burning ratio, and not the annual loss, is the true index of the situation. The burning ratio for farm property, because of inadequate fire protection, is high for the class of risk involved, and the annual loss of life and property from farm fires is