superphosphate increase 4% and miscellaneous phosphates (ammonium phosphates, liquid phosphoric acid, and other phosphates applied directly to the soil) increased 52%.

A boost in exports is also in store for phosphates during the coming year, the USDA reports, from 169,000 tons in 1954–55 to 210,000 tons in 1955–56. Meanwhile, imports are expected to decrease by 5000 tons to 65,000 tons.

U. S. to Become Net Exporter of Potash Next Year

The U.S. may become a net exporter of potash next year for the first time if USDA predictions hold up. Since the first World War, when the U. S. began producing potash, exports from this country have carried little weight in foreign markets, for the U. S. still depended to some extent on imported potash from Europe. Now, as predicted earlier this year (AG AND FOOD, July, page 559), the U. S. and the North American continent are in a position to wrest control of the international potash markets away from the European cartel. According to the USDA figures, the U. S. will export 146,000 tons of potash (on a K_2O basis) next year and import 138,000 tons leaving the U. S. a net exporter of 8000 tons. Not a large figure, the 8000 tons, but it does indicate that balance of power in potash is not stalemated.

Ultrasonics

New technique seeks —and probably will find— food processing jobs, but currently suffers from under-development, over-promotion

BEFORE the industrial application is made, more research work must proceed to determine the best conditions, technical as well as economical, for the application of such processes." This recommendation for caution, coming from a scientist who has performed considerable research with both experimental and commercial equipment, is probably a fair summary of scientists' estimation of a new food processing tool—ultrasonics.

For in the ultrasonics field, as has often been the case in other fields, the business seems to be getting ahead of the science. Equipment which has been found empirically to do certain jobs is already being merchandised—sometimes with more enthusiasm than is warranted by actual test results—while even the acknowledged experts are not certain as to exactly what the equipment is doing, and more particularly, why.

It has been known for a quarter-century that microorganisms in liquids could be killed by exposure to high-frequency sound waves; ultrasonics can in some cases also contribute to emulsification, flavor extraction, and other food processing operations. But there are numerous obstacles to overcome. In sterilizing foods, for example, treatment would be limited to nonparticulate matter, since ultrasonic waves cause disruption of organized matter in liquids. There would be little point in sterilizing noodle soup via ultrasonics, only to find that the noodles were completely disintegrated! Barrier effects of packaging materials also are a stumbling block, militating against in-package sterilization.

These and other drawbacks notwithstanding, scientists are not entirely pessimistic concerning a commercial future for ultrasonics in food processing. They do feel, however, that too little information of a fundamental nature is yet available, and that current promotional efforts in the commercial area, are in some cases perhaps, over-zealous. They point out in particular that present commercial equipment generally does not provide quantitative control, and in many cases does not even provide a means of measuring the level of energy output. In strictly mechanical operations, of course, the need for precision control is not always great, but for such applications as sterilizing milk, accurate control to assure quantitative results is imperative.

The Dim View

Not all investigators agree that sterilization of foods is a suitable field for ultrasonics. Stanley R. Rich of General Ultrasonics takes a dim view of ultrasonics in this application, having found in earlier (unpublished) investigations with chocolate sirup that, at the cavitation level, ultrasonic vibrations actually increased the growth of thermophilic spores; chocolate milk made from the treated sirup showed bacteria counts,

Ultrasonics equipment produced by Curtiss Wright can be used in the extraction of substances from hops for use in the brewing process

after pasteurization, five times as high as those in control samples. Thus, while some bacteria are destroyed as such, other forms such as spores may be encouraged, and little is known about possible effects on fungi, viruses, and other microbiological entities.

A real poser in applying ultrasonics to food processing is the difficulty of isolating the absolute effects of ultrasonic treatment. Total effect depends greatly on the pressure generated by the instrument, but it is influenced also by the substance itself, or the condition of the substance to which the sound waves are applied.

Seemingly incongruous results have been obtained by several groups in ultrasonic treatment of honey, for example. A team led by S. A. Kaloyereas at Louisiana State University found that application of ultrasonics destroyed the yeast and eliminated crystals present in honey, while other workers have found that sound waves actually favor crystallization in supersaturated solutions. These seemingly contradictory results can be explained, says Kaloyereas, by the differences in other substances present in the honey samples. At the University of Illinois, R. McL. Whitney and V. G. Milum have conducted limited experiments with honey, and have found that crystallization was retarded in some cases, but Whitney believes that much of the beneficial effect may have resulted from the secondary effect of heat generation within the sample, rather than from the primary effects of the ultrasonic waves.

More Mechanical Operation Most Likely Bet for Ultrasonics

It is in the less critical, perhaps more "mechanical" operations in the food processing industries that ultrasonics presently shows its greatest promise, and has made its best showing. Some manufacturers of equipment even here are overly optimistic, occasionally making claims which are not substantiated by performance, but there is a growing core of responsible manufacturers whose approach is one of selling commercial equipment only for applications in which it has been proved by test to be satisfactory. These people see as their immediate potential in the food field the replacement of conventional equipment wherever time or labor can be saved by a switch to ultrasonics. At the same time, however, they keep a watchful eye on research aimed primarily at the development of new food processes. It is always possible, they feel, that ultrasonics may make it possible to perform some operations not previously considered practical.

The extraction of flavors from solid substances is viewed by several experts —for instance, A. G. McKenna, president of McKenna Laboratories, and Stanley R. Rich, technical director of General Ultrasonics—as being perhaps the most fruitful field for ultrasonics. Extracting bitter substances from hops, recovering flavor components from coffee for the manufacture of instant coffee, and capturing vanilla flavor from beans are some of the processes in which ultrasonics might excell. It has been found on an experimental basis that ultrasonics can afford considerable acceleration in the extraction of such food products as coffee and tea, and there is no need for applying external heat—often damaging to flavor components.

Other Services from Ultrasonics to Food and Fiber

Food processing, of course, does not constitute the only avenue of service open to ultrasonics in the food and fiber field. Early experimental work has already disclosed additional possibilities, although here again much additional research is indicated. One interesting possibility was uncovered quite by chance by Kaloyereas and his coworkers at LSU. Attempting to apply sound waves for the disinfection of silkworm eggs, by destroying—inside the egg—the microorganism which causes the catastrophic silkworm disease known as pebrine, Kaloyereas found that the parasite was not destroyed but that another unexpected effect resulted: rapid incubation of the egg, which under normal conditions requires special storage and long incubations for the embryo to develop. This finding points toward the possibility of using sound waves to break the dormancy of seeds and also to improve germination.

Experimental work at the B. M. Harrison Laboratories indicates that ultrasonics might eventually have some application in the decortication of natural fibers. In early experiments with ramie fibers, the application of ultrasound was found to increase water penetration of the ramie stalks, an important prelude to the separation of individual fibers. While the work is not yet considered a practical solution to ramie decortication, it does hint of possibilities in this and other fiber applications.

The question of economics remains as one of the toughest for ultrasonics to answer. For some processes, original investment in ultrasonic equipment is already competitive with conventional equipment, but on the average the original cost is greater by a factor of from one to two. As might be expected, costs are relatively higher for batchwise than for continuous acoustic treatment; hence the most promising applications are those in which materials can be handled on a continuous-flow basis. As standardized equipment is developed, of course, and as increases in sales volume are effected, unit costs will be lowered. Operating costs of utrasonic equipment are in many cases about on par with those of conventional processing equipment.

While the market for ultrasonic research equipment today offers equipment manufacturers only limited chance for profit, faith in ultrasonics' commercial future keeps a number of firms active in the field. Curtiss-Wright, which sees the market for its research units this year as perhaps only $50,000 to $75,000, expects that by 1960 sales might jump to $1 to $2 million, and by 1975 they might reach $10 million.

The future for ultrasonics on production lines may indeed be rosy, but the rosy portion of that future is still quite far away. As of today, the cost of ultrasonics apparatus often far exceeds the value of the end result. In fact, says B. M. Harrison of Harrison Laboratories, it is almost axiomatic that when faced with a potential application for sonic energy the responsible sonics engineer asks, "Is there another way out of doing this?" If there is, it is probable that for the present, at least, the alternative method is cheaper.