ROTHAMSTED RESEARCH

The Use of Electricity in Agriculture

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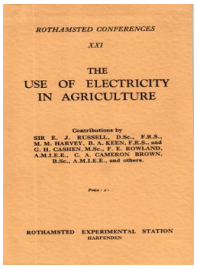

Communication and Replies Received After the Meeting

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A. N. D. Kerr; F. E. Rowland; C. A. Cameron Brown; G. H. Cashen; B. A. Keen (1937) *Communication and Replies Received After the Meeting ;* The Use Of Electricity In Agriculture, pp 73 - 77 **- DOI: https://doi.org/10.23637/ERADOC-1-213**

supply without a final inspection. Electricity could be a very useful help to the farmer but it must not be expected to accomplish everything. On his own estates, for example, his ploughing costs with paraffin tractors were only 1s. 2½d. per acre, whereas Mr. Borlase Matthews had quoted 2s. per acre for electric ploughing. In this connection he asked that any comparative measurements, such as those now being conducted at Rothamsted, should always be expressed, not in costs per hour, but per acre, or ton of material, as the case might be ; the farmer was interested in the cost of the job, rather than the cost per hour.

In dealing with the cost of electricity per unit he said there were two methods by which the cost could be reduced. Firstly by increasing the off-peak load as much as possible, and secondly by a general increase in consumption. An illustration of the first method was the use of crop drying equipment in summer. With regard to the second point he thought it was not generally realized that the actual production cost of electricity at the generating station was only a small fraction of their total charges. The total cost to the supply company was about 0.9d per unit, and of this amount the actual production cost was represented by only 0.13-0.25d. per unit. The bulk of the charge, therefore, was accounted for by interest, depreciation, and rates. An increase in technical efficiency at the generating stations could not therefore result in an appreciable reduction in the cost per unit to the consumer. On the other hand, an increased use of electricity, especially in the off-peak period would justify an appreciable reduction of the retail price.

The following communication, and replies to the discussion were received after the meeting.

Mr. A. N. D. Kerr (*London*).—There appears to be an impression that because the electric motor is an extremely efficient piece of apparatus, even at light loads, it may be run with impunity underloaded. This is true only of Direct Current motors ; with Alternating Current motors the question of Power Factor must be considered and this item is particularly serious for single phase motors, whose power factor is from 5 to 10 per cent less than that of the equivalent rating three phase machine.

A 20 h.p. 940 r.p.m. Three Phase Slip Ring motor having an efficiency of 87% would consume approximately 17 units an hour on full load and would take about 29 amperes of current on a 400 volt supply assuming the power factor was 86%. The useful current, however, is only 25 amperes : it is this ratio of useful current to current used which is the power factor. Only the useful current is measured on the kilowatt hour meter for the units consumed ; so that where the farmer pays for his current on a flat rate he is only indirectly interested (he is still interested, for though he does not pay any extra for the extra current, he has to provide cables capable of carrying the extra current), but where the farmer buys his current on a two-part tariff, for example, £4 per k.VA of

https://doi.org/10.23637/ERADOC-1-213

maximum demand over a period of, say, twenty minutes plus ¾d. a unit ; then though his running charge of ¾d. is unaffected by low power factor, his maximum demand and hence his fixed charge is increased by poor power factor.

In the case of the 20 h.p. S.R. motor, for example, the power factor at half load would be about 75% as compared with about 84% for a 10 h.p. motor operating on full load. In the first case the kVA. input would be 9.95, in the second case 8.9—a difference of approximately 1 kVA. or £4 a year extra by under-running the 20 h.p. motor.

If the farmer has a number of motors installed all underrun the power factor of his installation will be lower and the maximum kVA. demand higher (with consequent higher standing charges) than if he attempts to match his motors more nearly to his loads. In this connection it should be mentioned that the larger motor manufacturers employ trained engineers to advise on the correct application of their motors to the various drives and the services of such engineers are usually available free and without obligation.

It should also be remembered that all electric motors have a substantial overload capacity. All motors above 1 h.p. at 1000 r.p.m. are capable of withstanding 50% overload for 1 minute and 100% for 15 seconds ; in addition, motors above 10 h.p. at 1000 r.p.m. will carry 25% overload for 2 hours ; between 10 and 4 h.p. at the same speed, 25% for half an hour and from 4 h.p. down to 1 h.p. at 1000 r.p.m., 25% for 15 minutes. Even fractional horsepower motors (those below 1 h.p. at 1000 r.p.m.) will do 25% overload for 5 minutes.

Greater advantage could profitably be taken of this overload capacity, particularly as it is the minimum to which all British motors are built. (Foreign motors are not built to such a stringent specification.)

Now for a word on condensation. All motors need ventilation, primarily to get rid of the heat produced in the windings but also to enable the windings to be kept free from the effects of the humidity in the air. If the motors are totally enclosed—say to prevent injurious dust, grit, dirt or other harmful foreign matter from forming on the windings—then the heat can be dissipated only by radiation from the motor case. This necessitates a larger frame than is possible when the cooling air circulates among the windings. The total enclosure does not, however, render the motors air tight and as a consequence it breathes. When it is running and the windings are hot the internal air pressure is increased and the air driven out through the bearings and other machined surfaces ; when the motor is cooled, air is drawn in due to the lower pressure inside, and if the air drawn in is humid—as it usually is—then the water will condense in the windings. It is quite useless to try and minimise the intrusion of such humidity ; the best course is to help the water to get out once it is in ; and for this purpose small drain holes should

https://doi.org/10.23637/ERADOC-1-213

be drilled in the base of the motor casing at its lowest point. Any small amount of water which may then get in through such openings will still be able to get out again without collecting in pools at the base of the windings.

In conclusion, farmers are recommended to install squirrel cage induction motors wherever possible. They are low in first cost and, being rugged in construction, are reliable in service; the only moving parts are metal so that maintenance is a minimum, whilst their performance figures as regards efficiency and power factor are higher than those for the corresponding slip ring machines. The high efficiency means a low running cost, the high power factor a low fixed charge. Finally, their control gear is simple, inexpensive and robust as well.

Mr. F. E. Rowland : Mr. Harvey referred to the misleading figures which are sometimes quoted for the cost of generation with private plant. He stated that in the Electricity Commissioners Report a figure of 1d. per unit for private plant was given but I think he should have emphasised that this was for large commercial plant and not for the small equipment which would be used on farms. For the latter, partly in view of the poor load factor, overhead charges can amount to several pence per unit without taking into account any running costs.

Mr. Cameron Brown's paper was very interesting and a valuable one for discussion at a technical meeting. A lot of the information he gave was hardly required by farmers and may have appeared to make a simple subject appear to be complicated. Farmers should ensure that material of sound quality manufactured by firms of repute, is employed and the work carried out by competent contractors. Price should not be the first consideration for an electrical installation, particularly as there may be only a very small difference between a shoddy installation and a good one. Farmers as a rule do not purchase stock and other requirements solely on price, but consider quality as well, and this practice should be followed with electrical installations.

Mr. Rankin referred to the undesirable practice of some manufacturers fitting protected type motors on machines where totally enclosed should be used. This is undoubtedly so in some instances and is solely due to the fact that price plays such a large part in the sale of most equipment.

Mr. Bernard rightly sounded a note of warning against exaggerating the possible dangers of electricity. When properly installed and used, electricity is perfectly safe and it is only when simple precautions are not taken that danger arises.

Mr. Bernard's opinion that agricultural machinery manufacturers are inclined to quote too high figures for the horse power required by their machines is confirmed by the Rothamsted experience. The 20 h.p. motor which was used for the threshing experiments was supplied to drive the thresher and a chaffcutter, 15 h.p. being

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allowed for threshing based on the manufacturers figures. From the results it will be observed that a smaller motor would have been satisfactory.

Mr. Borlase Matthews stated that there are now 8,000 farmers using electricity in this country, but did not state on what basis this figure was calculated. 5,000 additional farms were connected last year and it is estimated that the number electrified is in the region of 25,000.

Col. Waley Cohen mentioned that the running charge of two-part tariffs should not be more than 1d per unit. It is desirable that this charge should be kept as low as possible to encourage the maximum use of electricity, although most operations can be carried out economically at a higher figure.

His remarks concerning the desirability of employing electrical contractors rather than supply authorities for installation work does not necessarily apply. The position varies in different parts of the country and a farmer should be able to judge from which firm in either category he should be able to obtain the most satisfactory service. The high cost of leakage trips has been referred to, and it should therefore be recorded that they are now obtainable at prices as low as 11/-.

Mr. Cameron Brown : It is evident from the remarks of Mr. Rankin and Mr. Bernard that the electrical industry is still afraid to be frank with the farmer and to admit that there must be with electricity, as with any other form of power or fuel, a certain amount of danger, but that there are adequate methods of meeting it. It is illogical to suppress this fact, while at the same time expecting the farmer to pay money blindly for special safety devices. A motor car salesman rather boasts about the danger on the roads and how *his* car is well equipped to meet them. Mr. Rankin mentions that these leakage trip switches are not available at competitive prices — competitive with what ? If they are necessary, and it is obvious from an earlier remark that he considers them advisable in many cases, then there is no question of competitive price save with one another—what price can one put on safety ? In any case, a first class trip costing 45/- will protect a 30 h.p. motor both for leakage and overload : can this be considered excessive when the motor and its accessories may cost anything from £40 to £100 ?

Colonel Waley Cohen's remarks on the difficulty experienced by the consumer in getting competent advice on his wiring layout and in finding competent wiremen rather negatives the opinions expressed by Sir Bernard Greenwell and Mr. Rankin that the Supply Companies are looking after that side of the question. Granted that only a good firm would give a five-year guarantee, of what practical use is that when the wiring is expected to have a life of anything up to thirty years. The provision that companies should not supply unless the installation is suitable is compulsory, but I should like to feel that any company does more than it is legally obliged to do in the

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way of making an insulation test. In any case, this inspection does not take place until *after* the installation is made. It is poor comfort to the farmer to know that he has had a bad installation made and that the company will not supply. He may, it is true, evade paying for this bad wiring but there is bound to be endless trouble and extra expense one way and another. The farmer should, when placing his wiring contract, have a clause binding the contractor to compliance with the Electricity Commissioners' Regulations and to the satisfaction of the supply company.

Mr. Cashen and Dr. Keen : Questions were asked by some speakers on the methods and conventions adopted by us in working out costings. The full details will be found in the Reports submitted to the Research Committee of the Royal Agricultural Society. One point, however, may be dealt with at once—the criticism that the cost of our electricity should have been taken as 1d. per unit and not 1.42d., which is made up of the tariff charge of 1d. per unit and an additional 0.42d. representing the quarterly fixed charge spread over a consumption of 3,061 units. The criticism was based on the argument that the fixed charge for the cost of transformer gear and low pressure line and the minimum use guarantee, are, in effect, a device for recovering from the consumer about 6d. per unit for his lighting (which was stated to be a not unreasonable figure), thus enabling the supply company to provide the consumer's power demands at a much lower figure, approximately 1d. per unit. Although we appreciate the criticism we feel that the method adopted in our paper gives the farmer the more correct position. The inclusive cost for an installation that is to provide both light and power will be greater than one supplying light only ; hence it is reasonable to debit part of the charge to the power consumption. The fixed charge is divided by our method between power and light in the same proportion as the units used for each. If the fixed charge is kept as a separate item in costings data, farmers will have difficulty in arriving at a simple comparison of the *total* relative costs of electricity and other forms of power (and lighting).

It is clear both from the papers and the discussion that the attitude of the farming community towards the fixed charge is, at the best, one of resignation. So long as this is the case, the cheapness of electricity, based on costings comparisons employing 1d. or even ½d. per unit, but excluding the fixed charge, will not completely convince the farmer.

https://doi.org/10.23637/ERADOC-1-213