Coal Washing by the Luhrig Process.*

By WALTER J. MAY.

Possibly there is no process of coal washing which is arranged the same as that of Mr. C Luhrig, and certainly no process can be arranged where the whole output of the mine is dealt with by the one process, as by carefully designing the machinery all unnecessary labour is avoided. The process is a simple one, and, like most simple processes, is very efficient. The whole process is simply the grading or sizing of the coal, the separation of each grade into pure coal, coal and tailings, and pure tailings (the second or intermediate result only being crushed to separate the waste), and thus a lot of both mechanical and manual labour is saved. In nearly all other systems of coal washing, the whole of the coal is crushed and afterwards washed, thus reducing everything practically to one size before beginning to separate it. This may act well, but when it is considered that what is to be removed from the coal is usually well defined in bands or separate pieces, the necessity for crushing everything does not exist, while power is wasted and the capacity of the machinery reduced.

Probably, coal will average about 2·16 per cent. to 3·20 per cent. in ash held in combination with the coal, but in many samples of manufacturing coals—and here we take from cobbles downwards—the percentage of ash and waste will be as high as 15 per cent., and with careful treatment in washing, this can be reduced to the normal average of the coal without undue breaking, as a rule, as coal under 4-inch cubes are usually fairly clean in part, while that under 2-inch cubes will be cleaner still, the dirt, or shale, or brasses being dissociated from the coal to a very great extent, although the whole will be mixed together. The actual separation now will be simple, after sizing, and the dirty stuff would need little crushing to separate the last portions of coal. Taking a coal with, say 4 per cent. ash and waste, in buying 100 tons, we obtain 96 tons of effective heating material, whereas if 14 per cent of ash and waste has to be dealt with, we only obtain 86 tons of heating material for which we pay the cost of 100 tons. To assume a case we will suppose a coal in all charges put into the furnace costs 10s. per ton, and that handling the ashes and waste all charges will come 1s. 6d. per ton, and this will work out as follows:—

	£	s.	d.
100 tons coal at 10s.	50	0	0
Handling 4 tons ashes and waste at 1s. 6d.	0	6	0
	50	6	0
Effective fuel for heating, 96 tons costing 10s. 5¾d. per ton net.			
100 tons coal at 10s.	50	0	0
Handling 14 tons ashes and waste at 1s. 6d.	1	1	0
	51	1	0
Effective coal for heating, 86 tons, costing 11s. 10·465d.			

This gives an actual money increase of 1s. 4·715d. per ton, or in the case of a place burning 25 tons of either sort of coal only per week, the poorer coal would cost actually per year, £90 10s. 9½d. more in proportion to the work done than would be the case with the one that was freest from ash.

Putting the matter another way, and assuming that 25 tons of coal giving 4·0 per cent. waste just effects certain work, we find that in fifty-two weeks we use so much coal and move so much ashes, and taking preceding assumed cost for the sake of comparison, of the better coal we use 1,300 tons and handle 52 tons of ashes and dirt, the total cost being £653 18s. This coal has an efficiency of 96 per cent., and if we take the poorer coal with an efficiency of 86 per cent., we shall want more coal, and also have to move more ashes, and the coal in such case should cost less per ton. In fact, it would require 1,451 tons to do the work of the 1,300, and instead of handling 52 tons of waste we should have to deal with 203 tons. The price for this coal should be only 9s. 0·145d. per ton, but usually neither purchaser nor vendor makes the waste a matter of consideration. Clean coal is the cheapest in the end, and should always be insisted on, as there is neither rhyme nor reason in using dirty coal.

So far as the Luhrig process is worked in this country, no doubt the plant at the North Motherwell collieries of Messrs. Merry and Cunninghame may be taken as being fully representative of the process now under discussion. In this plant about 1,500 tons of coal—as raised—is treated daily, and this is brought to a platform by means of rope drives, and here the hutches or corves are discharged by means of tipplers on to vibrating screens of metal plates with round holes of about 2in. diameter, and all that passes these screens is washed, while the large passes on to picking tables, in which the ordinary plates are replaced by round rods having spaces between them, through which the dirt and small coal can pass, when dislodged, in dressing the large coal. This dry separation plant is in a separate building to the wet plant and in addition is worked by a separate engine so as to be independent of the wet plant As the coal passes over the tables, stones and dirt are picked out, and the shale is chipped off any pieces where necessary, while the clean coal is delivered into waggons by the belt, which has an adjustable arm and is raised or lowered as required to prevent breakage of the coal as it falls into the waggon. In the sorting, clean stone and dirt free from coal is taken directly to waste and is done with, but coal combined with shale or stone is taken to a coal breaker to be broken up for further treatment, and is carried back to the other dirty coal or dross.

Coming now to the wet separation, the whole of the dross is elevated to the top of another building, and at once delivered into a revolving drum, which sizes into nuts, beans, peas and dust, and from this drum the different sizes are conveyed by shoots to jigs, in which the coal is separated into three classes—(1) clean coal, (2) coal intermixed with shale or brasses, and (3) dirt free from coal. Only coal above ⅜ in. is treated in these jigs, which are of special design, and made to treat large quantities. The waste is taken away to the pits by means of spouts, and the clean coal is taken over drainers into hoppers for loading, while the intermediate stuff is elevated to the top of the building to be crushed in a roller mill, and from here it passes to the proper jigs to be again separated. The fine coal from the sizing screens under ⅜ in. passes with the overflow water from the nut coal jigs to special grading boxes, and from these it passes to jigs with suitable meshed grids, having felspar beds, and is there thoroughly cleaned, the dirt being taken to the pits, and from thence lifted to waggons for removal by means of an elevator, while the clean coal passes into a draining drum, whence the water and fine coal are taken to a sludge pit, and the pearls are conveyed to large storage hoppers. From the sludge pit the fine coal is collected by means of a patented sludge-recovery apparatus and lifted by an elevator either into separate hoppers or into the pearl coal hoppers, according to the use it is to be put to. Roughly this is the whole process, and the cost for labour in washing is practically ½d. per ton, and at Motherwell the ash is reduced from 23 per cent. to 2·5 per cent.

At Ellenborough Colliery, Maryport, a sample of the small coal held 13·78 per cent. ash before washing, and the pearls after washing 2·78 per cent., while the pearls and sludge mixed after washing 4·14 per cent. ash and 0·85 per cent. sulphur; 52 tons 13 cwt. treated for this result gave 46 tons 8 cwt. coal, and 6 tons 5 cwt. waste, in which there was 2·8 per cent. of coal, while the proportions of the cleaned coal gave 86·48 per cent. pearls and 13·52 per cent. sludge. Another sample of coal at the same colliery gave before washing 5·24 per cent. of water and 22·41 per cent. ash, while after washing, water stood at 4·94 per cent. and ash 4·48 per cent,

In a Scotch coal treated, the percentages of clean coals gave 41·84 per cent of "treble" and "double" nuts worth 7s. 9d. and 6s. 9d. per ton f.o.r. mine, 30·61 per cent. "single nuts" worth 4s. 6d. per ton, 10·21 per cent. "peas" worth 3s. 9d. per ton, and 17·34 per cent. "sludge" worth 3s. per ton. Before washing this was a very dirty coal but now the ash hardly exceeds the fixed ash by a figure in the second decimal place, while instead of being worth from 6d. to 8d. per ton, it will run out over 3s. 6d. per ton on the crude.

Possibly the wetness of the washed coal will be objected to, but this wetness does not exist, as except with the sludge the water drains off very readily, and having had washed "peas" from Scotland the writer can say that the water was no trouble, but peas are too small for all boilers, and this occurred in the case of the boilers referred to. Nuts and beans, or all sizes above, say, ⅜ in. cube should dry in a very short time when exposed to the air in waggons, and the cost of this detention would not be much.

For coking purposes the washing of the coal gives good results, and at the Ellenborough Colliery, Maryport, where the coal was regarded as non-coking prior to the erection of washing plant, good cokes have been produced, and the following will show what results are obtained. Slack before washing contains 22·41 per cent. ash, and after washing pearls (air dried) show 4.48 per cent. ash, pearl and sludge (air dried) 7·38 per cent. ash, and sludge (air dried) 11.90 per cent. ash. Now, taking these in the same order, pearls gave 50·72 per cent. coke, carrying 8·10 per cent. of ash; pearls and sludge, gave 53·05 per cent. of coke, carrying 13·40 per cent ash; and sludge gave 51·52 per cent. coke, carrying 17·44 per cent. ash. Of course, this is not an average, and to get this it is necessary to take the average for some months, and if we take that of the coke made at the Maria-Anne and Steinbank Collieries, Bochum, Westphalia, it will be found that the average ash for March 1880 was 47·45 per cent., the highest being 5·031 per cent. and the lowest 4·099 per cent., while an average for the nine months ending March 31, 1880, gave a daily result of 4·7815 per cent., the lowest monthly average being 4·575 per cent., and the highest 5·096 per cent., the difference being 0·521 per cent. only, which shows how level and uniformly the process works. The percentage of coke to coal is not given, but assuming it to be 50 per cent., we get only 2·39 per cent. ash in the coal before it is carbonised. Prior to washing plant being put up, the coke carried 10 per cent. ash.

Pyrites or brasses, when sufficiently plentiful, can be saved, and are worth varying sums, according to their content, in some cases being sufficient to pay for the whole of the working expenses; but in any case they are worth separating, if in anything like appreciable quantities, but if not, then they can pass away to waste.

Coming to the cost of washing, we have to take all costs and charges in connection with the process, and then to this we have to add the loss in bulk, when this is worth anything. Take, as an instance, a crude slack, worth, in its dirty state, say 2s. 6d. per ton at the pit, and which contains everything under 1 in. Now the possibility is that quite 20 per cent. of separable waste exists in this, and that the clean coal would contain nuts and coal above ⅜ in. to the extent of 50 per cent., the balance being coking stuff. Taking, say, 100 tons of this, we get a value of £12 10s. for the crude to start with, and, as we lose 20 per cent. in bulk in the waste, this brings the average of the coal saved to an original cost of 3s. 1½d. per ton. Assuming that the nuts and beans are in equal quantities, and worth, respectively, 5s. 6d. and 4s. 6d. per ton, and that the coking stuff is worth 3s. 6d. per ton; we get as follows:—

	£	s.	d.
40 tons coking coal (pearls and sludge), at 3s. 6d	7	0	0
20 tons peas or beans (⅜ in. to ⅝ in.), at 4s. 6d.	4	10	0
20 tons nuts (⅝ in. to 1 in.), at 5s. 6d.	5	10	0
	17	0	0

Taking the Luhrig Company's own maximum estimate of $\frac{8}{10}$ of one penny per ton for dressing, we get 6s. 8d. as the cost of dressing only, but as there are other charges incident to all machinery which may well be taken as raising the charges to 3d. per ton on the crude, this gives £1 5s. as cost of dressing, and the account would stand then as follows:—

	£	s.	d.
To 100 tons coal at 2s. 6d.	12	10	0
" Dressing, all charges, at 3d.	1	5	0
	13	15	0

Against this we have 80 tons sold and used as under:—

	£	s.	d.
By 40 tons coking coal at 3s. 6d. per ton	7	0	0
" 20 tons peas at 4s. 6d. per ton	4	10	0
" 20 tons nuts at 5s. 6d. per ton	5	10	0
	17	0	0

This gives a net profit of £3 5s., and if 200 tons per day were treated for each of 300 days per year, we should get £3 5s. + 2 + 300 = £1,950 per year net profit, besides having to provide waggons for 12,000 tons less coal, which would be equal in working to five 10-ton waggons daily, hence the saving in waggon repairs would be considerable.

Naturally, every plant erected will have to meet the requirements of the variety of coal dealt with, and the purpose for which the clean coal has to be turned out, and this prevents any hard and fast lines being laid down either as to cost of working or cost of erecting: but as some idea of these charges may be worth having, it may be taken that an average cost for erecting plant for handling 1,000 tons per day would be £9,000, and the annual charges would be practically as follows:—

	£	s.	d.
Depreciation 10 per cent £9,000.	900	0	0
Interest at 5 per cent. on £9,000	450	0	0
Repairs	20	0	0
General charges, say	380	0	0
Steam, wages, stores, process, &c., at 1½d. per ton	1,875	0	0
	3,625	0	0

On 300,000 tons this is equal to 2·9d. per ton, but even allowing the cost to run out to 3d. per ton or £3,750, there is a good margin for profit, as clean coal will always sell where dirty coal will not.

For instance, at a certain works, 28 tons of coal (slack) was the weekly average consumption of 30 weeks, not more than 6 per cent. of waste coming from the boilers, and keeping an average pressure of steam of 50 lb. (the man in charge of the boilers was fined 2s. 6d. if the boilers blew off steam at 53 lb., or if pressure sank below 47 lb., and the fines were sharply enforced). This slack cost 13s. 9d. delivered, and averaged about 20 cwt. 42 lb. to the ton. Well, there was a new manager, who, of course, had new trades people, and he had a new coal, and this new coal was "screened nuts," at 12s. 6d. per ton for 21 cwt. net delivered; 98 tons were delivered, and lasted eleven days to keep up the steam needed, an extra man being put on to help the ordinary stoker, as over 40 per cent. of waste was produced (the actual weight being 39 tons 19¼ cwt.). The coal was good, what there was of it in a clean state, but in an unclean state it was little better than shale, and its value may be taken as follows:—28 tons of slack, plus 10½ cwt., cost £19 5s., which gives the price as 13s. 5.96d. per net ton, and in eleven days 44 tons would have been used on the average, and would have cost £29 13s. 10.24d. On the other hand, 98 tons plus 98 cwt., cost £61 5s., or 11s. 10.86d. per net ton, and to this must be added the extra labour, £2 4s. for the eleven days, which made the cost actually £63 9s. Compared together, the dear slack cost £2 13s. 11·84d. per day, and the cheap nuts £5 15s. 4·36d. per day. One experience of this kind was enough, and no more nuts were required, but had the nuts been clean, they would have been of more value as fuel than the slack, as sundry lumps which were analysed only gave an average of 1·031 per cent. ash.

A new mineral, not unlike asbestos in its properties, has been discovered in immense deposits in the United States of Colombia. It is stated to be the colour of amber, perfectly transparent, and incombustible. Experiments made at Bogota indicate that it will be of great value for the manufacture of bank-note paper, for fire-proof and water-proof roofing tiles, and for suits for firemen. A white varnish can also be extracted from it. The substance has been named bucara-manquina, and it is expected to prove of greater importance than asbestos.

* Colliery Guardian.