Specification of Henry Young Darracott Scott : treating sewage.

A.D. 1871, 26th AUGUST. N° 2243.

SPECIFICATION

OF

HENRY YOUNG DARRACOTT SCOTT.

TREATING SEWAGE.

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A.D. 1871, 26th *August.* N° 2243.

Treating Sewage.

LETTERS PATENT to Henry Young Darracott Scott, of Ealing, in the County of Middlesex, Major-General, C.B., for the Invention of "IMPROVEMENTS IN THE TREATMENT OF SEWAGE FOR THE PURPOSE OF OBTAINING THEREFROM USEFUL PRODUCTS, SUCH AS MANURE AND CEMENT."

Sealed the 22nd December 1871, and dated the 26th August 1871.

PROVISIONAL SPECIFICATION left by the said Henry Young Darracott Scott at the Office of the Commissioners of Patents, with his Petition, on the 26th August 1871.

I, HENRY YOUNG DARRACOTT SCOTT, of Ealing, in the County of Middlesex, Major-General, C.B., do hereby declare the nature of the said Invention for "IMPROVEMENTS IN THE TREATMENT OF SEWAGE FOR THE PURPOSE OF OBTAINING THEREFROM USEFUL PRODUCTS, SUCH AS MANURE AND CEMENT," to be as follows :—

The object of this Invention is to reduce the cost of the purification of liquid sewage by precipitating solid matters, and then producing from such precipitate marketable substances such as manure and cement.

Scott's Improvements in the Treatment of Sewage.

In carrying out my Invention I add from 16 to 32 grains of lime more or less to every gallon of sewage operated upon in any of the modes usually practised. The precipitated solid matters obtained are collected and dried on hot plates or otherwise. I then expel from the solid matter the carbonic acid gas which has combined with the lime (in the act of precipitation) by calcining it in heaps or in a kiln, oven, or retort. In this process of calcination the combustible organic matters in the precipitate also assist. Such calcined precipitate will consist of quicklime, phosphate of lime, and other foreign ingredients, and I employ this either as cement or mortar for building purposes, or as a manure, in the same manner as is practised with the ordinary lime of commerce; or I may make use of it for precipitating a fresh quantity of sewage with a view of further enriching it with phosphoric acid. I slake the calcined precipitate and add to it a sufficiency of water to make a milk of lime, and allow the phosphate of lime and the coarser foreign ingredients to subside. The supernatant milk of lime I employ for the precipitation of a fresh quantity of sewage, and the precipitate thus obtained I treat in the manner above described. I repeat this operation again and again until I have collected a sufficiency of the phosphate compound to be dried and sent into the market for manure. In certain cases I simply re-burn and re-use the precipitate obtained without making use of the subsiding process until the lime is sufficiently rich in phosphoric acid to be a valuable marketable article.

The process possesses the advantage of admitting of the use in connection with it of other precipitating and disinfecting substances, which will contribute also to the value of the material produced when used as a cement or mortar, such as clay, salts of iron, or soluble or partially soluble sulphates.

When clay is used with the lime and added to the sewage as a disinfectant or decoloriser, and calcined with the precipitate sewage, it will produce a hydraulic cement.

In lieu of the quicklime of commerce I may employ gas lime or other lime refuse for the precipitation of the sewage. When such refuse lime is rich in hyposulphites these substances will be found especially useful as disinfectants.

Scott's Improvements in the Treatment of Sewage.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Henry Young Darracott Scott in the Great Seal Patent Office on the 26th February 1872.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, HENRY YOUNG DARRACOTT SCOTT, of Ealing, in the County of Middlesex, Major-General, C.B, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-sixth day of August, in the year of our Lord One thousand eight hundred and seventy-one, in the thirty-fifth year of Her reign, did for Herself, Her heirs and successors, give and grant unto me, the said Henry Young Darracott Scott, Her special licence that I, the said Henry Young Darracott Scott, my executors, administrators, and assigns, or such others as I, the said Henry Young Darracott Scott, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN THE TREATMENT OF SEWAGE FOR THE PURPOSE OF OBTAINING THEREFROM USEFUL PRODUCTS, SUCH AS MANURE AND CEMENT," upon the condition (amongst others) that I, the said Henry Young Darracott Scott, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Henry Young Darracott Scott, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the Drawing hereunto annexed, and to the letters and figures marked thereon (that is to say) :—

This Invention relates to improvements in the treatment of sewage matters obtained by precipitation, and producing therefrom by means of calcination marketable substances such as cement or manure.

Scott's Improvements in the Treatment of Sewage.

In order to effect the precipitation of the chemical matters contained in the sewage, I add from sixteen to thirty-two grains of quicklime (more or less) to every gallon of sewage water in any of the modes usually practised. The amount of lime to be used will depend upon the richness of the sewage in those matters, which will form with lime insoluble compounds such as carbonate or phosphate of lime.

The precipitated solid matters when obtained are collected and dried on hot plates or slip kilns, as is practised in the manufacture of Portland cement, or they may be dried in any other convenient way. If preferred, the solid matters may be partially dried and made into the form of perforated bricks, in which condition they can be kept for an indefinite period without giving off any disagreeable odour, and the completion of the drying can then be allowed to take place slowly. I then expel from the solid matter the carbonic acid gas (which is precipitated in combination with the lime) by calcining the solid matter in heaps or in a kiln or oven, which together with a drying floor may conveniently be constructed in the manner shewn in the accompanying Drawing.

Fig. 1 is a longitudinal vertical section of the kiln; Fig. 2 is a horizontal section or sectional plan view of the same; Fig. 3 is a transverse vertical section taken in the line 1, 2, of Fig. 1; and Fig. 4 is a similar view taken in the line 3, 4, of Fig. 1.

a, *a*, is the compartment in which the cakes, bricks, or lumps of the dried precipitate are placed for the purpose of being calcined. It is provided with a doorway or opening a^1, which when the kiln is charged is bricked up. *b*, *b*, is the fire-place which is used to commence the firing, and which is fed through the opening b^1 above or through the mouth b^2. The fire-place *b* is separated from the calcining compartment by a perforated wall *c* constructed in fire-brick, or it may be built up with the material to be calcined. The calcining chamber *a* is constructed, as shewn in Fig. 3, in the form of a pointed arch, and is provided with an arch $a^\times$ for the purpose of causing the heat to descend and act on the substances to be calcined. Openings *d*, *d*, *d*, are also made in the sides or upper part of the chamber for the escape of steam or to admit air to support combustion, for which latter purpose the inlets *g*, *g*, *g*, in the end wall and floor of the chamber also serve. The heated gases and flame from the fire-place *b* will pass through the

perforated wall *c* and act on the solid matters in the chamber *a*, and as these matters contain a very large amount of combustible organic matter they will quickly ignite and burn, thereby so far contributing to the calcination of the lime and clay contained in the solid precipitate. After the fuel in the fire-place *b* has once fairly ignited the combustible organic matter contained in the dried solid precipitate, the fire in the fire-place will be no longer required, and therefore need not be supplied with fuel. The space above the ignited fuel in the fire-place may therefore be filled up with the dried precipitate, which may be thrown in through the opening b^1 above. The fire-place must then be closed, or nearly so, in order to prevent the access of too much air. The heated gases evolved from the calcining substance will pass along the hollow floor or flues *f*, *f*, beneath the shallow vessel *e*, *e*, in which the wet slip is placed for the purpose of being dried. When the gases have parted with their heat they will pass on to and ultimately escape up the chimney. The shallow vessel *e* for drying the slip may be covered with a galvanized iron roof, as shewn at Figures 1 and 4, and above the calcining compartment *a* another drying chamber for completing the drying of the solid precipitate may be constructed, as shewn at *h*, *h*, Figures 1 and 3. Part of the gaseous fuel driven off from the calcining precipitate may if desired be conducted into a separate chamber instead of into the flues under the drying floor, as shewn in the Drawing, and by the admission of fresh air such gaeous fuel may be burned, and the flame may be employed for the calcination of the chalk or limestone to be used in the preparation of the lime intended for the precipitation process; or by employing a double kiln the calcination of the precipitate may be effected in one compartment, where I obtain cement from this precipitate, while the gaseous fuel serves in another compartment to produce caustic lime from chalk or limestone, or for other purposes. When the solid precipitate is subjected to distillation in closed retorts previous to being calcined, the gases produced may be used for all purposes for which such combustible gases are now employed, and the calcination of the precipitate may subsequently be completed by the admission of air into the retorts, or otherwise igniting the carbonized compound.

The precipitate when properly calcined will consist of quicklime, phosphate of lime, and other foreign ingredients, and I either pulverise this and employ it for mortar for building purposes, or I use it for a

manure, in which latter case it has the advantage over ordinary quicklime that it contains a larger per-centage of phosphoric acid. I sometimes however make use of the calcined precipitate for the precipitation of a fresh portion of sewage water, and in this case I obtain a compound comparatively rich in phosphoric acid by means of a subsiding process, which is practised as follows:—The calcined precipitate having been slaked (by preference with boiling water), a fresh portion of water is added to produce with the quicklime present a milk of lime, and the whole having been thoroughly stirred, time is given to allow the coarser foreign ingredients and the larger portion of the phosphate of lime present to settle to the bottom of the vessel in which the operation is carried out. The supernatant milk of lime is then run off into the sewage water, which has to be purified. The precipitate produced is then dried and calcined, and the slaking and subsiding processes are repeated.

The same operations may be carried out again and again, and the material thus collected may be sent into the market as a dry powder for manure, or it may be converted into superphosphate of lime in the ordinary way.

If necessary the coarser siliceous compounds may be separated by a similar process of decantation. In some cases I run in the milk of lime, and after stirring the liquid I allow the matters remaining undissolved to subside, and then run off the top water (charged with lime in solution) in order to precipitate the sewage. In this case, owing to the small extent to which lime is soluble, I employ a large amount of water, which however I obtain by pumping back the clarified effluent sewage water. It is also necessary to make use of three or more stirring vessels for this process, so as to have the operations of stirring, settling, and decantation continuous. By this means the phosphates can be more effectually separated from lime than when the milk of lime (which carries with it to the precipitating tanks a considerable amount of phosphate) is allowed to run into the sewer without settling.

In lieu of these subsiding processes I sometimes add the whole of the calcined precipitate first obtained to the second portion of sewage water to be operated upon without extracting the phosphate of lime from it. and by repeating this operation again and again I at last obtain a lime compound sufficiently rich in phosphoric acid to constitute it a valuable manure. For the purpose of preparing manure on the above system I

prefer for obvious reasons to precipitate with lime containing phosphoric acid.

The above described process and results refer to sewage of normal character, but owing to local circumstances and special manufactures (the washings from which find their way into the sewers) the nature of the sewage sometimes undergoes considerable modifications. In some places considerable quantities of sulphate of iron and sulphuric acid are discharged into the drains, and the precipitate produced by lime may consist chiefly of oxide of iron mixed with organic matter, which latter is destroyed by the subsequent calcination to which my process subjects it, and anhydrous oxide of iron mixed with siliceous and calcareous matter (valuable for gas purifications as well as for a puzzuolanic cement) is obtained. For the last purpose I prefer to mix with the precipitate before calcination some quicklime slaked to a fine powder, or to use gas lime as it comes from the gas works as the precipitant; or I may use a mixture of lime and chalk to produce similar results.

My Invention has the advantage of admitting of the use in connection with the lime of other precipitating and disinfecting materials, such as salts of iron, or alumina, or soluble or partially soluble sulphates, or clay, for the purpose of more efficient purification or the production of a marketable article of greater value. For instance, by the addition of one part by weight of clay to every two or three parts more or less of lime present, the resulting precipitate will yield after calcination a hydraulic cement. I would remark that the best results are obtained when the silex in the calcined material amounts to one-fifth or thereabouts of the whole. As some variation occurs both in the quantity of silex present in the sewage water and of lime in the clay used, attention must be paid to these circumstances in proportioning the ingredients. By the addition of oxide of iron, sulphate of iron, sulphate of alumina, or chloride of iron, I can prepare a cement which shall have approximately the composition and action of Medina, Roman, or Mulgrave cement, these cements varying in the proportion of iron and alumina they contain. The iron and alumina salts will at the same time more perfectly disinfect and precipitate the flocculent matters suspended in the sewage water.

With a view of improving the quality of the cement I sometimes add two or two and a half per cent. of sulphate of lime in a finely divided

condition, or a small per-centage of sulphuric acid, or some soluble sulphate, to the precipitated sewage whilst in the wet condition, and at the same time if desired small quantities of salts of soda or of potash may be introduced in order to increase its rapidity of set.

Portland cement may be obtained by the addition of the proper proportion of clay as compared with the lime present or obtained in the precipitate, and then completely burning the whole of the fuel contained in the deposit by a freer access of air than is necessary when a tender burned cement is aimed at. Portland cement (as is well known) contains from twenty-two to twenty-four per cent. of silex and ten to fourteen per cent. of iron and alumina, and is usually made of about sixty-five per cent. of lime and thirty-five per cent. of clay, but as all sewage contains these ingredients in varying proportions, the proportions of lime and clay to be added to the sewage matters (when Portland cement is to be produced) must of course vary. It will therefore be necessary to ascertain by analysis the quantities of clay and lime contained in the sewage, and then regulate the addition of further quantities of these substances accordingly.

In lieu of the quicklime of commerce gas lime or other lime refuse may be employed for the precipitation of the sewage and the preparation of the above calcareous marketable compounds. The best mode of proceeding in this case depends upon the nature of the refuse lime. If very rich in hyposulphites (as is frequently the case with gas lime partially oxydised) the operation is commenced by washing out the soluble salts. The residue is calcined in a heap oven or kiln and employed (when slaked) for the purposes of precipitation. When the refuse lime is not rich in hyposulphites it is calcined and used for the precipitation of the sewage without a previous washing process. With the view of more thorough mixture and agitation of the chemicals employed with the sewage water, the chemicals should by preference be added at points of the sewer distant from the outfall, whereby expensive mixing and agitating machinery is rendered unnecessary, and the sewers are themselves purified. With the view of increasing the quantity of cement produced when the organic matter in the sewage is abundant or fuel very cheap, I sometimes add to the sewage, besides the lime and clay necessary for its precipitation, such a quantity of chalk and clay in the proportions ordinarily used in the manufacture of Portland cement as can be economically dealt with both in respect of labour and fuel.

Having now described my Invention, and having explained the means whereby I carry the same into effect, I wish it to be understood that under the above in part recited Letters Patent I claim, the process or processes above described for treating precipitated sewage for the purpose of obtaining useful products therefrom as herein set forth.

In witness whereof, I, the said Henry Young Darracott Scott, have hereunto set my hand and seal, the Twenty-fourth day of February, in the year of our Lord One thousand eight hundred and seventy-two.

HENRY Y. D. SCOTT. (L.S.)

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SCOTT'S Specification.

(1 SHEET)

FIG. 3.

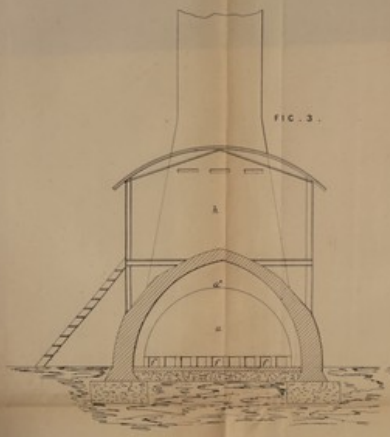


FIG. 1.

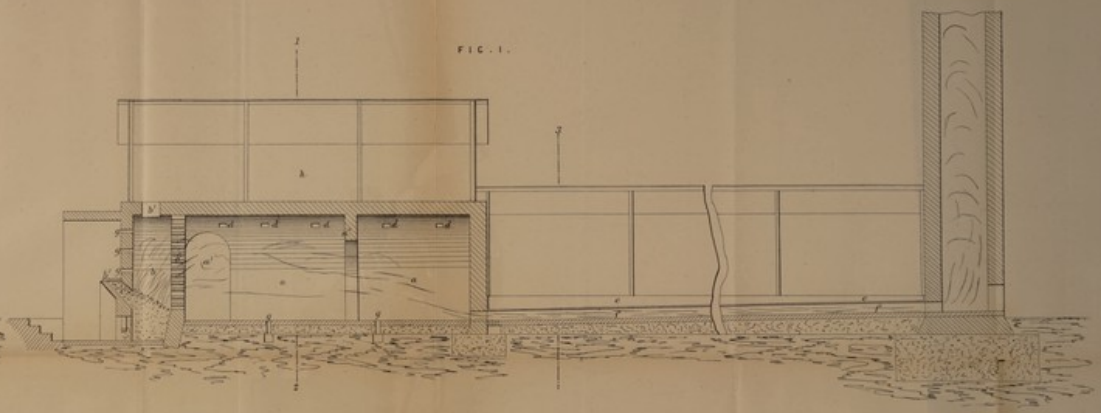
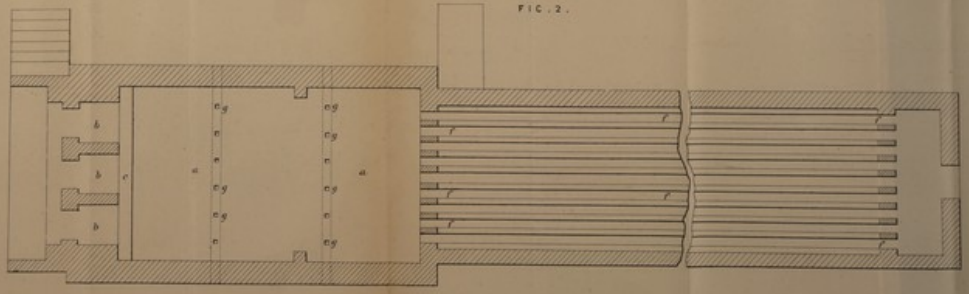


FIG. 4.

FIG. 2.



This drawing is partly colored.

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