A Note on Calcining of Bones as a Village Industry

By

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Manuring of crops for increased production without disproportionate increase in the cost of production is aimed at by all producers, and in this endeavour, simple process of conversion of bones as a cheap phosphatic manure is presented below for adoption in villages. By a judicious combination with, green manures, compost, farm yard manure, oil cakes and nitrogenous fertilisers, it has been established, that the phosphate manure plays a very important role in higher crop yield. Different crops remove from the soil varied quantities of phosphates, and unless the loss is recouped, the gradual decline in fertility with consequent low yields will be obvious. The Government in their Government Order No. 2693, dated 10—7—'46 ordered publication of work on calcination for the benefit of ryots. This article it is hoped, will stimulate the village Industry and benefit the ryots.

Cheap and simple process of phosphate manufacture:

Though raw bone is easy to collect and cheap in the villages, by the time it reaches the cultivator as bonemeal it becomes too expensive for the cultivator. The raw bones are hard and by a simple process they can be rendered brittle. The factory process involves sulphuric acid treatment which is expensive and requires scientific knowledge. The process described below needs paddy husk, or groundnut husk or saw dust or chaff of grain which are available in the villages. The village tanner has no use for the bone. He throws them away. The agriculturist should see that he utilises the bones of his cattle as much as he cares for the hides by adopting the simple process. Three processes are described below:

A. Heap process:

A layer of bones is laid flat and round on a bedding of husk. A row of bricks is arranged leaving a 6″ wide and 4″ high gap along the diametre for air inlet or outlet. This channel should be in line with the direction of the wind of the season. The channel is covered with parallel arrangement of bones. Husk is spread over this and another layer of bones is arranged. Again this is covered with husk. All the bones are put similarly one over the other forming into a steep pyramid. In this arrangement hard bones of the legs and the vertebra should be placed in the centre, and light bones like the ribs and skulls towards the sides, because as the heat moves up, the former would get sufficient heat at the centre and the latter less heat at the sides. Heat is thus uniformly utilised and there may remain no unburnt or over burnt bones when done

with. When all the bones are piled up a final layer of husk is spread and a 3″ thick moist earth put all over the heap, leaving the inlet and outlet at the base. One-fourth the weight of the bones is the husk required. Fire is introduced in at the inlet. The husk and the bones inside catch fire after a few minutes. In about an hour copious smoke with characteristic odour will emit which is a sign that brisk heat is at work. Now close the bottom smoke outlet and open 3 or 4 small outlets on the top of the pyramid. The heat is thus forced upward and the smoke will now emit at the top holes. If the wind blow is fast, regulate the air inlet at the bottom with a brick. All that is required is, steady heat; too much heat will result in more of calcium carbonate and loss of phosphate. The process should not be hurried through. In three or four days the process will be complete. During the course of the second day a few cracks may develop on the heap which should be closed up then and there with mud. The completion is indicated by the absence of smoke at the outlets and the heap is luke-warm to touch. The mud plaster is removed. Properly heated bones are ashy brown in colour, over heated ones, white, and imperfectly heated ones, black. The bones are now quite brittle and can be powdered in mortar and pestle or rolled in chunam mortar.

B. Cattle kiln process:

Like the *chunam* kiln a permanent structure with unburnt bricks or stones is suggested when continuous manufacture is needed. A kiln 4′ in diametre and 5′ in height will hold a ton of bones. As in the heap process the bones are piled up till they are a foot above the wall, and the top portion mud plastered. A few smoke exit holes are made at the top. Due to the vertical move of the heat calcining is effected quicker than the heap process. The air inlet at the base of the kiln can be used to remove the calcined bones. After removal the kiln is ready for the next charge.

C. Conduction heat process:

In the above two processes, the bones come in direct contact with fire and the resultant product loses 3% nitrogen. To minimise this loss it was devised to render the bones brittle enough by heat conduction. The bones are arranged in several narrow rows parallel and close to one another. An inch of wet-earth is put over the bones. It was noticed above, two and a half times the weight of bones is the quantity of husk required. Fire is set to the husk in line with the direction of the wind. The husk as it burns conducts the heat to the bones inside through the thin layer of mud plaster. When groundnut husk is used it should be moistened with water lest it should run into flames and thus burn away quickly. The burning must be slow and steady. When the husk is completely burnt the mud plaster is removed. The bones are brittle but not so

brittle as in (a) and (b) processess. On analysis 2·5% nitrogen is retained, but the total and citric soluble P_2O_5 contents are less than the other two products. It is easier to adopt the heap and the kiln processes, and the loss of nitrogen is minimised by reducing the quantity of husk used.

Analysis :

Head of analysis	L. No. 340		L. No. 341		L. No. 342		L. No. 343		L. No. 344	
	Air dry basis	Moisture Free basis	Air dry basis	Moisture Free basis	Air dry basis	Moisture Free basis	Air dry basis	Moisture Free basis	Air dry basis	Moisture Free basis
Moisture	3·74	...	3·08	...	3·29	...	3·83	...	2·53	
Loss on ignition	9·21	9·57	19·67	20·30	20·23	20·92	16·87	16·85	6·21	6·37
Insolubes	0·85	0·89	1·09	1·12	0·82	0·85	2·03	2·09	1·49	1·53
Nitrogen	1·12	1·16	2·54	2·52	2·48	2·56	2·05	2.11	0·45	0·47
Total P_2O_5	36·00	37·41	31·47	32·46	32·22	33·25	32·72	33·67	37·24	38·20
2% citric soluble P_2O_5	26·11	27·13	24·74	25·50	24·36	25·20	25·70	26·45	22·56	23·15

Cost of Production : At the outset it may be said the village should be the centre of manufacture of the manure. Village labour may be employed for the collection of the bones and doing the rest of the job. This will give them additional income. At present the bone collectors are advanced small sums by the town agents of the bone exporting concerns and head loads of bones are brought to the agent's depot in the town. The head-loads are cursorily judged, of their weight, or weighed with a hand spring balance. Deductions for moisture in the bones from 40% to 60% are made and the head-load fetches Re. 0—4—0 to 0—8—0 per 56 lbs.

Below the details of cost of production include the cost of bones purchased in Nellure Town and the labour costs and other charges incurred. In actual practice the value can be roughly put at half or even less than the figures given below :

A. Particulars 1943.	Value.
Cost of 2,126 lbs. of raw bones	Rs. 50—0—0
Carting to work site	2—8—0
Cost of paddy husk-332 lbs. (1/4 the weight of bones will suffice)	2—8—0
Weighing the bones and arranging them in heap	2—8—0
Watchman, weighing the final produce	1—4—0
Powdering in mortor and pestle	2—4—0
Total	Rs. 61—0—0

2,126 lbs. of raw bones yielded 1,400 lbs. of calcined bonemeal. Therefore 1,400 lbs. costs Rs. 61/- which works out to Rs. 97—9—7 or Rs. 98/- per ton or Rs. 4—9—5 per cwt.

B. Demonstration in 1947. at Madaraju-gudur (Nellure Taluk).

Particulars.		value.
Cost of bones 15,500 lbs.	Rs.	519—0—0
Cost of paddy husk 6,500 lbs.		16—0—0
Weiging bones and husk		0–12—0
Heaping and plastering		6—0—0
Fixing and weighing		0–12—0
Removing the heap and weighing		3—8—0
Total	Rs.	546—0—0

15,500 lbs. raw bones yielded 9,920 lbs. of calcined bones.

Therefore recovery = 64%.

Cost of 9.920 lbs. of calcined bones	Rs.	546—0—0
Cost per ton	Rs.	122–10—0
Cost per cwt.	Rs.	6—2—0 or
	Rs.	6—3—0

I feel the authorities would be convinced that decentralization of bone utilisation so as to limit the collection and use within each taluk area would be cheaper than centralizing bonemeal manufacture at a few Provincial factories.

A comparative analysis figures of the following phosphatic manures show that calcined bonemeal has good percentage of total and citric soluble P_2O_5. The market prices and the unit prices of the P_2O_5 are compared. The fear of competition and consequent reduction of costs of factory made phosphates need not be entertained as the method of procurement of bones in the villages, the simple process employed in its preparation, and, the absence of costly technical guidance remain the factors in its favour.

Comparative Analysis of Different Phosphates and Unit Prices:

The unit prices worked out below clearly show that calcined bonemeal is the cheapest of all phosphatic manures and therefore worthy of general adoption in villages.

Kind of phosphatic manure.	nitrogen %	Total P_2O_5.	Citric soluble P_2O_5 % to total P_2O_5.	Market value per ton.	Unit prices.
Steamed bonemeal	4·4	23·6	50	Rs. 160/-	Rs. 6–12–6
Bone super ordinary	...	22·0	...	200/-	9—1–6
Bone super concentrated	...	43·0	95	300/-	7—0–0
Basic slag	...	17·2	80	200/-	...
Rock super	...	16·1	...	200/-	...
Calcined	0·47	38·20	...	...	...
Bonemeal	0·56	33·25	...	98/-	3–10–0

The value and the unit price of calcined bonemeal in actual practice will be a fourth in the villages where the value of bones is negligible, and the waste material and labour are part and parcel of the cultivation.

Below is given the analysis of calcined bonemeal from different demonstrations in Nellore District. It may be seen that P_2O_5 could be maintained at about 38%.

	L. No. 373. (a)	L. No. 929. (b)	L. No. 930. (c)	L. No. 931. (d)	L. No. 932 (e)
Moisture content	2·64	4·73	5·71	6·22	3·50
Loss of ignition	2·99	1·55	19·28	8·48	1·74
Insolubles	1·24	0·41	1·05	1.12	1·13
Nitrogen	...	0·11	2·04	0·98	0·14
Phosphoric acid	37·15	37·88	29·72	33·28	37·54

Samples (a) (b) and (e) are grey in colour and contain only small quantities of nitrogen and organic matter, indicating calcination has been complete. Sample (d) is dark grey in colour and sample (c) is almost black in colour at the bone chard stage.

Bones which are merely charred are less readily decomposed in the soil than completely calcined bones.