

AMMONIUM CHLORIDE FROM PAZAWAS.

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In Watt's Dictionary of the Economic Products of India, 1889, p. 219, it is stated that ammonium chloride or 'naushadar' used to be manufactured by potters (kumhars) in Kangra (Punjab) from village refuse. Apparently, the industry has died out there but, in certain of the tehsils in Patiala State and some villages in Karnal District and Saharanpur, ammonium chloride is still being manufactured in the process of baking crude bricks in village kilns called 'pazawas' which are fired by means of village refuse. This material is collected from time to time and stored until the brick-making season starts towards the end of March.

The process, which differs materially from that described by Watt, is as follows:—

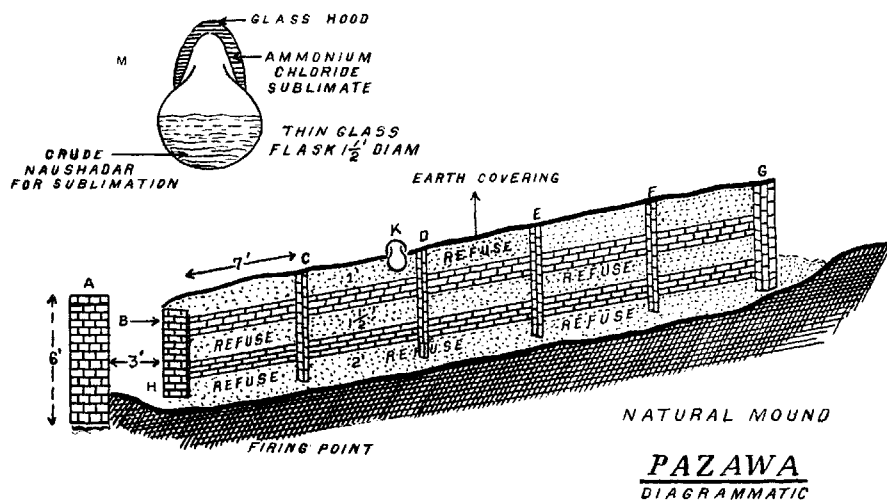


Fig. 1.

The diagram represents a vertical section through the middle of the length of a pazawa except that, as described below, the vertically placed small bricks shown at *C*, *D*, *E*, *F* and *G* are removed before a new section of the pazawa is added.

At the end of the kiln and separated from it is erected a wall, *A*, about 6' high. At a distance of about 3' from this, a wall, *B*, is built in which has a hole or bridge, *H*, through which the kiln is first fired. A layer of dry village refuse 2' thick is laid down and then two or three layers of sun-dried clayey-

mud bricks lying lengthwise and flat are superimposed. Upon this are laid alternately a layer of refuse, a layer of bricks and lastly a third layer of refuse, the whole being usually but not invariably plastered over with mud.

The pazawa is built on a mound at an angle of 25 to 30° with the horizontal and is about 10' wide at the base or firing point and gradually widens out until, at the 'free' and upper end, it is about 40-50' wide. Each successively broadening section is about 7' long, the total length of the kiln after two or three months being 50-60'. Thus, the plan of the pazawa is roughly that of a section of a sloping isosceles triangle about 10' at the lower end and 40-50' at the upper extremity.

When the village refuse in the first section is fired, usually with the help of wood fuel in the first instance, it burns slowly and, after some time, ammonium chloride deposits gradually on the layer of smaller damp bricks, *C*, vertically placed at the end of the section at right angles to the general run of the bricks to be baked. Sometimes the bricks are moistened during the process. When the burning has nearly reached the end of the 7' section as shown by the appearance of a white fume, the little bricks, which are now quite dry, are removed and scraped to remove the ammonium chloride containing deposit called 'crude naushadar' which is mixed with more or less earth in the process. This leaves the end 'open', though the fuel in the first section is not entirely consumed.

Another section, about 7' long is then added on to the free end, widening out somewhat and finished off by small vertical damp bricks as before. When white fume again appears, the small bricks are removed as before and scraped, the final pazawa being as shown in the diagram, with the vertical bricks at *C*, *D*, *E*, etc. removed.

After the fire in the stack has proceeded to the fourth or fifth stage, the bricks in the earlier sections can be removed progressively after cooling and sold. The total process takes from two to three months.

The number of bricks manufactured in a pazawa varies between 50,000 and 1,50,000.

The bricks should be made of 'straight' clay without the addition of sand and the potters say that the smaller the bricks the better the yield of naushadar (crude ammonium chloride) obtained. Sometimes, large pieces of ammonium chloride called 'pāpri' are formed.

Some potters put crude earthy naushadar into earthenware pots (*vide* figure, *K*) which are placed in the upper refuse layer during the slow combustion. By this means, the ammonium chloride is sublimed into a sun-dried clay receptacle. This is ultimately broken to recover the product which is coloured yellow.

If fuel other than village refuse, *e.g.* wood or coal, is used, ammonium chloride is not formed at all, while it is found that the greater the proportion of cow and camel dung and material of that kind in the refuse, the better the yield of 'naushadar'.

After the burning, much yellowish ash remains which consists mainly of silica and aluminium silicates, with small amounts of iron, sodium and potassium silicates and traces of chlorides. Its potash content is equivalent to about 4.5% K_2O .

The following gives an idea of the prices obtained for the various products (1941):—

- (1) Crude naushadar is sold for from Rs.2 to Rs.5 per maund depending on the relative amount of earth it contains (13–30% NH_4Cl);
- (2) Crude crystals or 'pāpri' (85–92% NH_4Cl) are sold at Rs.12 to Rs.15 a maund;
- (3) The yellowish product from *K* (91–95% NH_4Cl) described above which realises about Rs.16 to Rs.20 per maund;
- (4) The 'bells' of whitish salt (over 99% NH_4Cl) described in (a) below which fetch Rs.25 to Rs.28 per maund; and
- (5) Pure crystals (99.8% NH_4Cl) obtained by process (b) below which are sold at about Rs.35 per maund.

The above kinds of crude substance are treated broadly in two different ways:—

- (a) By sublimation. The crude material is heated in thin-walled vessels made of dark coloured country glass about 18" in diameter and the ammonium chloride is sublimed into 'bells' made of a similar quality thin glass. The whole of the plant is smeared over with several layers of mud. The process is similar to that described in Watt but the flask has no neck. The sublimed ammonium chloride is recovered from the bell by smashing the glass when a thick shell of whitish ammonium chloride is obtained (*vide* Fig. 1, *M*).
- (b) By lixiviation, sedimentation, crystallisation, centrifugalisation and so on. By this more modern process, a very pure product is obtained which sells at Rs.35 a maund, its purity being over 99% NH_4Cl . A demonstration factory maintained by the Punjab Government is in operation at Kaithal in the Karnal District to instruct villagers in purifying their products.

It has been alleged that the ammonium chloride rises in the clay from the dried ponds and elsewhere by capillary action and that, for this reason, suitable clay is only available at certain times of the year. So far, no specimen of clay received has contained more than traces of ammonium chloride and the proportion of sodium chloride is very small. The village rubbish, as received, contains varying amounts of sodium chloride but no ammonium chloride, the production of this salt being apparently due to a complicated action which takes place during the slow combustion of the village refuse under the peculiar circumstances described.

In the opinion of the writer, this is the source of all of the ammonium chloride produced but the matter needs proper investigation both with the object of discovering if the process could be more widely used as a village industry for the manufacture of ammonium chloride independently of the brick industry, which even now is sometimes subordinate to it, and as an interesting problem dealing with the slow combustion of such material as village refuse of the type used in the pazawas.

It was pointed out that this source of NH_4Cl could not compete with that readily obtained as a by-product in the ammonia soda process for making soda ash already established and in course of further development in India, but that, as a village industry, it was worthy of encouragement as serving a worthy purpose where the refuse was not more urgently required as a manure.

At the meeting of the National Institute of Sciences held in Delhi on April 19th, 1941, at which the paper was read, a number of members took part in the discussion which followed, notably Sir S. S. Bhatnagar and Dr. J. L. Sarin, Industrial Chemist, Punjab.

In preparing this note, I am indebted to Mr. Kashmiri Lal Budhiraja, Chemist to the Patiala Government, for much general information regarding the process and to Mr. Manohar Lal, Assistant Chemical Examiner of the Central Revenues Control Laboratory, for collecting and analysing samples from working pazawas.