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Commercial and Industrial uses of 'Kallar'

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Kallar is a local term for saline condition of soils and is regarded as anominus sign when it appears on the land of a farmer. The presence of 'Kallar' or salinity, affects crop growth adversely and consequently is a threat not only to the individual land owner but also to the prosperity of the nation, if the menace is wide spread. Unfortunately in the canal colonies, both old and new, the effects of salinity are very extensive, so much so, that in the canal irrigated tracts of the old province of Punjab, which now consists of three Divisions *viz.*, Lahore, Multan, Rawalpindi of West Pakistan, there are about 2.4 million acres infested with salinity. The critarion fixed for this estimate is that when 20% or more of an acre possesses visible salts incrustation at the surface the entire area is included in the category of saline soils. The area which has salts within 20% an acre is roughly estimated as 4·6 million acres. The salts are generally present in the form of white incrustation consisting of sodium chloride and sodium sulphate. The highest concentrations of these salts are present at the soil surface and in most cases these persist even upto lower depths.

The removal of excessive quantities of these salts presents a major problem to the farmer. Various methods have been tried by him for making the soils free of salts. Scrapping of salts from soil surface was done by him but this did not solve his problems as more salts reappear from the subsoil with upward movement of moisture under arid atmospheric conditions. The scrappings of Kallar from soil surface consist of varying percentages of soluble salts. There had been practically no use for them and instead, these were serving as a source of meance to the well being of this country. It was considered desirable to find the possible industrial or commercial uses of 'Kallar'. Various experiments were conducted to prepare chemicals on a laboratory scale by using 'Kallar' as a starting material and its industrial applications are discussed in this paper.

The composition of 'Kallar' varies widely from place to place but except in very limited localities where nitrates are also present, the main constituents are sodium chloride and sodium sulphate. Two samples of scrappings obtained from Jaranwala (District Lyallpur) and Muridke

(District Gujranwala) were collected for the purpose of experiments. The analysis results of the water soluble portion are given below :—

Chemical Constituents.	Percentages.	
	Jaranwala sample.	Muridke sample.
Carbonate ...	Nil	Nil
Bicarbonate ...	1.35	0.89
Chloride ...	30.35	31.98
Sulphate ...	32.30	30 06
Calcium ...	1.30	0.88
Magnesium ...	0 13	0.02
Sodium ...	33 90	34.99

The percentages of soluble salts are 13.7 and 21 5 respectively in Jaranwala and Muridke samples. These samples were collected after rains in the month of August and therefore do not have the maximum quantities of soluble portions. If the samples are collected after December they are expected to yield the maximum percentage of soluble portion. In the winter months it is easier to locate the salty spots as these are clearly visible in the form of white incrustation. It is possible to collect 'Kallar' samples having soluble portions upto 40% or more, in the months of January to early March.

Manufacture of Sodium Carbonate.

The most widely used sodium salt after common salt is sodium carbonate, usually known as 'Soda ash' or 'washing soda'. The starting materials for its preparation is either sodium chloride or sodium sulphate.

The manufacture of soda-ash from these raw materials is carried by the well known Solvay[1] and Leblanc[2] methods respectively throughout the world. It requires a heavy machinery and special plants to make use of sodium chloride for the purpose but a simple revolving furnace is needed for the manufacture of sodium carbonate from sodium sulphate. Expreiments were therefore, conducted to make use of sodium sulphate part of 'Kallar' by first extracting the

salts with water and then crystallising the same to obtain pure sodium sulphate. Also the 'Kallar' sample itself was used as such for the preparation of sodium carbonate. 'Kallar' or sodium sulphate was heated with varying percentages of calcium carbonate and carbon at about 600°C The resulting mass was lixiviated with water to get sodium carbonate in solution. The reaction is known to take place in the following way ;—

(1) Sodium sulphate + 2 carbon =
Sodium sulphide + 2 carbon dioxide.

(2) Sodium sulphide + calcium carbonate =
Sodium carbonate + calcium sulphide.

Table below shows the percentages of sodium carbonate that could be formed from various 'Kallar' samples.

Description of 'Kallar' sample	Percentage 'of Kallar'	Percentage of $CaCo_3$	Percentage of carbon	Percentage of $Na_2 - Co_3$ formed on weight of 'Kallar'
Salt extract from Jaranwala Thur sample.	40	54·8	5·2	14·2
	50	42·3	7·7	14·9
	53	39 1	7·9	12·6
	55	36·4	8·6	12·4
	60	30·7	9·3	11·7
Salt extract from Muridke Thur sample.	37 5	50·1	12·4	11·6
	40·0	43·3	12·7	13·0
	42·8	44·4	13·8	13·3
	40·2	39·5	14·3	12·7
	50·0	34·9	15·1	11·3
Thur incrustation from Muridke	50·0	28·2	21·8	4·0
	53·0	24 8	22·2	4·0
	55·0	22·0	23 0	4·2
	60·0	16·8	23·2	4·6
	65·0	10·7	24·3	4·4

It is observed that sodium carbonate could be formed from 'Kallar' directly as well as by using the extracted salts. It is however difficult to separate sodium carbonate when sodium chloride is present. The extraction of pure salt is not economical when compared to the other methods of preparation. However, the mixture so obtained can directly be employed for washing purposes. In this way the sodium carbonate so produced can be used economically and can effectively replace the washing soda.

If sodium sulphate is crystallised first and obtained in a pure form, in that case purer sodium carbonate can be produced

The advantages in this case are the cheapness of raw meterial and possibilities of taking up the industry on a cottage scale after further details are worked out. However there is a definite handicap, the raw material, *viz.* 'Kallar' being largely scattered and collection for a large scale industry would present a problem of collection and transportation.

This collection has been tried during the pre-partition days of Indo-Pak subcontinent quite successfully. What is needed is an organization which would offer attracting terms to village folks to get the stuff collected and leave the transport responsibility to supply depots. There have been such organizations in past which collected large quantities of the raw material for different purposes.

Manufacture of Sodium Thiosulphate.

Sodium thiosulphate is extensively used in photographic work under the commercial name of hypo, and also in other analytical chemical processes. The final product in the preparation of sodium carbonate as described previously, is taken and sulphur dioxide is passed to the saturation point and further charge of sodium carbonate is added. The mixture so obtained is boiled with sulphur powder. The solution is further concentrated and sodium thiosulphate crystals are obtained. This method has been employed in the industry for a long time but attempt has been made in this paper only to point out the possible use to which the 'Kallar' can be put in for profitable purposes. The results so obtained with various specimens of 'Kallar' are given below :—

TABLE 2

Description of 'Kallar' sample	Weight of 'Kallar' taken	Percentage of $Na_2 So_3$ formed
Salt extract from Muridke 'Kallar' sample ...	59 gm.	19·3
Salt extract from Jaranwala 'Kallar' sample ...	33 5 gm.	21·9

It is observed that sodium thiosulphate can be obtained as second stage product from 'Kallar', through sodium carbonate process. This method has a good scope for production of this chemical.

During the second world war there was a great scarcity of this chemical. There was lot of profiting and black market prices were charged. The waste salt can be turned to a useful salt for use in photographic trade.

Use of 'Kallar' as Refrigrant alongwith ice :

It it known that ice and common salt mixtures can produce temperature below freezing point and have been used for various purposes in our daily life. Salts can be obtained cheaply from 'Kallar' and it has been observed that 'Kallar' or salts obtained from the same can effectively be used in freezing mixtures.

The lowering of temperatures produced by mixing various salts with ice as observed by other investigators is given in the table below :—

TALE 3

Salt	Percentage	Maximum Depression.
Sodium chloride.	24.8	—21.3°C
Sodium nitrate	33.3	—17.7°C
Sodium carbonate.	16.7	— 2.0°C
Potassium nitrate.	11.5	— 2.9°C
Ammonium nitrate.	57.1	—44.7°C

The lowering of temperature produced by 'Kallar' or salts present in it was determined and the results so obtained are given in table below :—

TABLE 4

Description of Kallar sample	% age of ice in ice Kallar mixture	Temperature of ice.	Final temeprature after mixing of 'Kallar'	Lowering of Temperature.
Salt extracts	8	0°C	—6.5°C	6.5°C
from Muridke	12	,,	—8.9°C	8.9°C
Kallar sample	16	,,	—8.2°C	8.2°C
Salt extract	11	,,	—6.7°C	6.7°C
from Jaranwala	13	,,	—9.5°C	9.5°C
Kallar sample.	16	,,	—8·2°C	8.2°C
Muridke Kallar	57	,,	—1.1°C	1.1°C
soil sample.	76	,,	—1.3°C	1.3°C
	Excess	,,	—1.2°C	1.2°C

It would be observed that there is practically no advantage of using 'Kallar' directly. However the salts extracted from the same can be useful for the purpose and may find a market to replace common salt or potassium nitrate in the preparation of freezing mixtures.

Purification of oils by means of 'Kallar'.

Salting out of soap by means of 'Kallar' is possible due to the effectiveness of sodium chloride and sodium sulphate in breaking up the soap emulsion. This property can be made use of in the purification of vegetable oils for commercial uses *viz.* for the manufacture of soaps. The dark colour of oils is due to vegetable green matter which after docomposition gets dissolved in the oil to give it such an appearance. Such oils are generally used to produce low grade soaps in this country

Experiments were conducted to purify mustard oil which was very dark in colour. 50 cc of the oil were treated with 5 cc of 0.25% sodium hydroxide, the mixture shaken thoroughly and allowed to stand. Sufficient quantities of 'Kallar' sample was added to coagulate the soap which was allowed to settle. This resulted in the removal of colouring matter and a pale yellow oil was produced resembling the fresh oil. If the salts extracted from the 'Kallar' are used without any soil portion

then the soap which settles down with black colouring matter, can also be usefully employed although it is of inferior quality.

The soap produced in this way can also be used as cheap laundry soap but more or less with the efficiency of normal laundry (desi) soaps available in the market. The quantity would be inferior due to colour only and may fetch slightly less price.

Use of 'Kallar' Extract as Soap Adultrant.

Oils are the glycerides of the higher fatty acids and their sponification with an alkali solution results in the formation of sodium salt of the acids which in common is termed as soap.

The weight of soap formed depends upon the amount and strength of alkali used and the amount of oil consumed. The quality of soap in turn depends upon the purity of alkali as well as of the oil used.

It has been practiced since old days to mix some foreign matter in order to increase the weight of the soap. Generally soap stone was used as an adultrant but the appearance of white salts and cracks on soap surface has made its use obsolete.

Sodium silicate is under use for the purpose now-a-days. Salt extract from 'Kallar' were tried as soap adultrant, and the results are tabulated below :—

TABLE 5

Description of 'Kallar'	NaoH used	Oil used	Weight of 'Kallar' used	Weight of soap formed
Salts extract from Muridke Thur sample	40 cc	10 cc	Nil	5·8 gms
	,,	,,	5 gms	7·4 ,,
	,,	,,	6 ,,	9·7 ,,
	,,	,,	8 ,,	10·4 ,,
	,,	,,	10 ,,	9·8 ,,
Salts extract from Jaranwala Thur sample	40 cc	10 cc	Nil	5·8 gms
	,,	,,	5 gms	7 8 ,,
	,,	,,	6 ,,	9·4 ,,
	,,	,,	7 ,,	8·2 ,,
	50 cc	,,	Nil	6 9 ,,
	,,	,,	4 gms	8·3 ,,
	,,	,,	6 ,,	11·5 ,,
	,,	,,	7 ,,	10 6 ,,

When 40 cc. of N/10 sodium hydroxide was mixed with 10 cc. of oil 5.8 gms. of soap was formed. In other experiments where caustic soda and oil are used in the same quantity but when 5, 6 and 7 gms, of 'Kallar' extract was added the soap formed weighed 7.8 gms. 9.4 gms. and 8.2 gms. respectively.

In a similar experiment where 50 cc. caustic soda and 10 cc. oil are used the weight of soap formed was 6.9 gms. When 4, 6 and 7 gms. of 'Kallar' extracts were added the soap formed weighed 8.3, 11.5 and 10.6 gms., respectively. In both these experiments the weight of soap formed was approximately doubled by the addition of 'Kallar' extract. A fair percentage of the salts extracted from 'Kallar' can be used for hardening washing soap (local variety).

Preservation of leather by means of Kallar.

From the dawn of civilisation man has been using skin of the wild and domestic animals for miscellaneous purposes. With the advancement of science and luxurious needs of man, methods were evolved for improving the quality and life of skin. The first step of skin processing is its preservation and local methods were adopted and practiced, Due to increasing demand from oversea countries as well as, internal needs, those who took up skin preservation on a commercial scale, made huge profits.

After recovery from the animal body the skin is vigorously rubbed with blunt edged wooden scraper for removing the last traces of flesh and fat to prevent nitrogeneous putrification which may cause bad smelling and early deterioration of skin. The skin is then spread and common salt rubbed against its inner side with a view to dehydrate it and avoid the attack of micro organisms which would distroy the skin otherwise. This is the common process used in the country for skin preservation.

In this experiment attempt was made to use both 'Kallar' as such. as well as, salts extracted from it. Fresh skins of sheep were taken and fatty and fleshy material was completely scrapped off. Common salt was thoroughly rubbed against inner side of some while the others were treated similarly with salts extracted from the 'Kallar' samples These were left for two days Afterwards skins were again treated with same salts as before and kept in shade for a further period of 4 days. The process was repeated twice again after which the skins were spread in open air to dry up. Drying in direct sunlight has to be avoided to get better results Some fresh skin was similarly treated with 'Kallar' sample as originally obtained from the field. After a few days period the skins were dried up and it was noticed that all the skins were equally good w th no difference in the quality. It is observed that animal skins can be preserved by using both 'Kallar' and salts extracted out of fit.

A local stuff resembling 'Kallar' is being used for a similar purpose in the East Pakistan, although the substance is not being produced from any waste material. There is a reasonably good scope of putting 'Kallar' to this use without any high cost.

Preparation of Potassium Nitrate.

In some places 'Kallar' sample is found to contain potassium nitrate and a small extent of its chloride in addition to the usual sodium salts. This is a very good and cheap source of the important chemical potassium nitrate which has scores of applications in industry *viz.*, explosives, fire works, pickling meat, etc. The areas where the 'Kallar' containing nitrate is present is generally near villages and abadis.

The method which can be adopted in a cottage industry for the manufacture of potassium nitrate from 'Kallar' is described below :—

'Kallar' is collected through surface scraping in the months of December to March when usually it shows off as white incrustation on the soil surface. The collections are brought to a centrally located field where two small ditches are prepared by plustering them with clayee soil so as to reduce percolation of water. 'Kallar' is allowed to dissolve by runing water into the ditch The whole staff is thoroughly stirred by wooden paddles and allowed to stand so that the soil material settles down. The supernatant liquid is transferred into another ditch prepared similarly adjacent to it. The solution is allowed to dry under the sun and finally the dried salt mixture is scrapped off. The dried salt mixture makes the starting material for final purification process.

Except using his own free time labour the farmer usually spends nothing for the collection of the raw material. He can easily sell the same at Rs. 5/- per maund. Often he may collect so much material that it can well be regarded as a great economic help in his uplift.

The cottage scale factory can be started with a small capital and the schematic diagram is shown as Fig. 1. The raw material is dissolved in water in a pan and concentrated by boiling. Sodium chloride and sodium sulphate settle down in the concentrated solution while the more soluble potassium nitrate remains dissolved. The hot brown liquid is carefully transferred to a settling tank where any suspended material together with sodium sulphate or chloride settles down and the supernatant liquid is syphoned off by an adjustable hose to a large shallow tank and allowed to cool.

The pure crop of a potassium nitrate crystals are formed in 2 to 3 days time but usually complete crystallisation takes place in 8 to 10 days. The mother liquid can again be mixed in the evaporating tank to remove any sodium sulphate or chloride left. Sodium chloride and sodium sulphate mixture can be utilised for salting skins and may fetch an additional return to the industry. Potassium nitrate can be sold for Rs. 15/- to 20/- per maund.

There is a considerable internal as well as external market for pure Potassium nitrate. The tea and tobacco planters in Malaya and Siam largely employ this material as chemical manure.

The information given in the paper is mostly applied to few industries but it may lead many to pay attention to such a raw material which is so abundant and cheap but neglected as being only a source of nuisance and troubles. This raw material is so widely spread that many hands in the villages can usefully employ their free time for their own economic benefit. No wonder that the stuff which is causing shadows on the horizon of our agricultural prosperity may become a source of profit to our village community to some extent.

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FIG.

SCHEMATIC DIAGRAM SHOWING.
PURIFICATION AND CRYSTALLIZATION
OF POTASSIUM NITRATE

