

BCM-BIO-POTASH – A boon to Farmers
And - Alcohol Industry

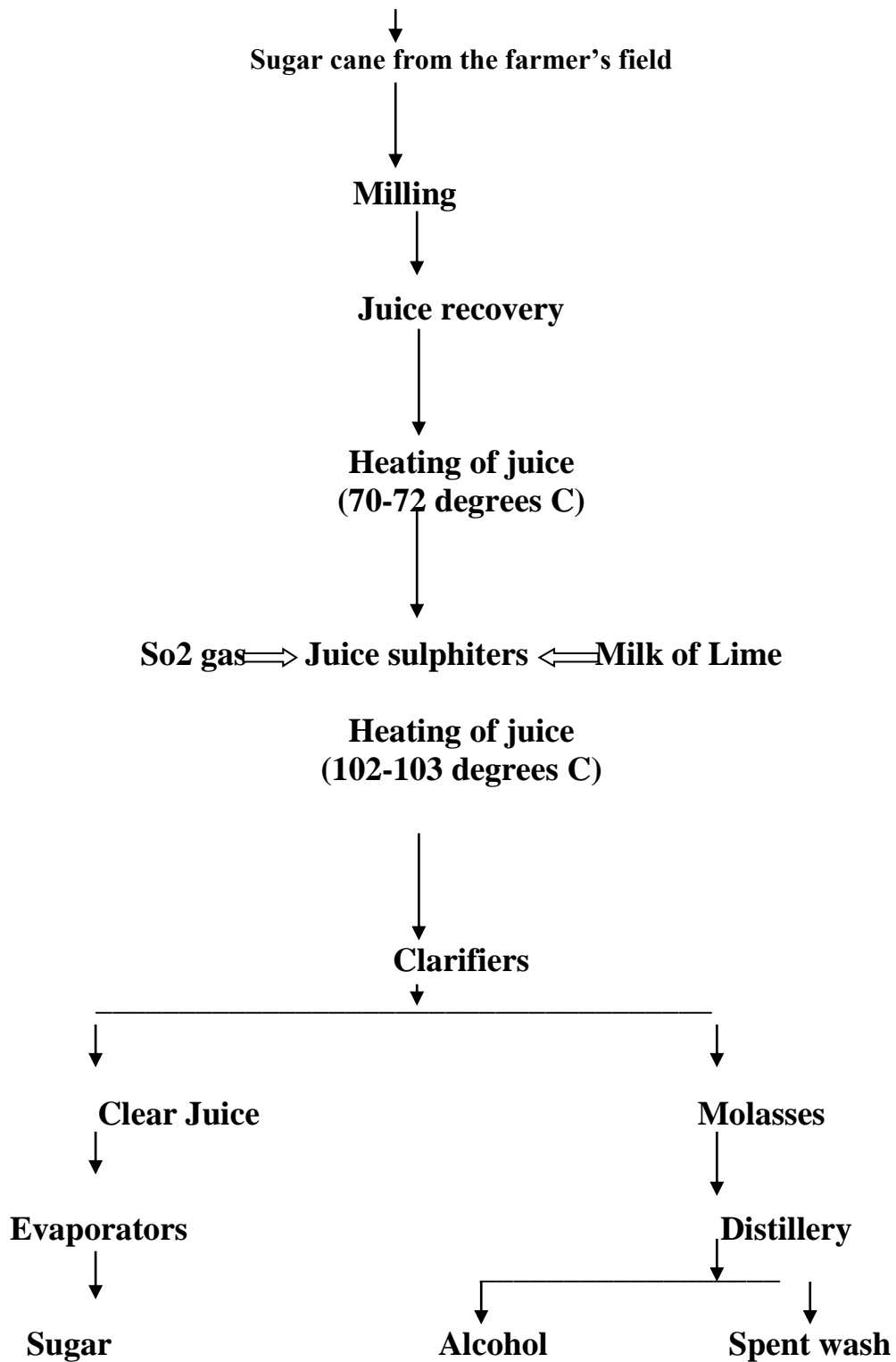
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Abstract:

Sugarcane is a farmer friendly and industry friendly plant, all the parts of plant as well as by-products and wastes are utilised for the economic development of the society. Cane is crushed to make sugar, molasses is a by-product comes out after the production of Sugar in the Sugar industry. This by-product is the raw-material for the Alcohol production in the Distilleries. Once, the Alcohol is made, a waste is left behind known as the *Spent wash*. If this spent wash is not properly utilized it can cause pollution. Hence, Balrampur Chini Mills Ltd, Chemical Division, has installed an incineration boiler to convert this spent-wash into ash and with the help of Bag Filters *potash rich ash* is collected for fertilizer use. This ash contains large amount of water soluble *Potash about 20% K₂O*. This Potash is in elemental form and thus plant can utilize this for their excellent salubrious growth.

The present paper is elaborating the use of the Potash and the utilization of the Pollutants with economical returns to the industry.

Process Flow Chart (sugar, Alcohol & Spent wash)



Majority of distilleries use molasses as a feed stock. Balrampur also have a molasses base distillery. Apart from its use in beverage, medicines, pharmaceuticals and flavouring, alcohol constitutes the feed stock for a large number of organic chemicals which may be used in the production of drugs, rubber, pesticides and solvents. Ethyl alcohol is an important feed stock for the manufacture of various chemicals like acetic acid and butanol, butadiene, acetic anhydride, polyvinyl chloride etc. Alcohol blending with Petrol is increasing, 5 percent blending is only applicable in 10 States and three Union Territories and requires about 410 million litres of anhydrous alcohol. Increments in both percent blending and geographical spread are anticipated. Molasses based distilleries are classified as a 'Red' category Industry by the Central Pollution Control Board. With the amount of highly polluting, spent wash being generated at 10 to 15 times the volume of spirit produced, it is an area of major environmental concern. A report suggests that there are 325 molasses based distilleries in the country producing 3063 million litres/year (M.Ltr/year) of alcohol and generating 45945 M.Ltr/year of spent wash as waste annually (*Yashpal 2014*).

Composition of Spent wash

It has been reported that the 45 billion litres of spent wash produced in the country annually have a potential to produce 1,200 million cubic meters of bio gas (containing 60% methane) and the post methanated water if used carefully can produce more than 85,000 tons of bio mass annually. It has also been estimated that utilization of spent wash may provide 5 trillion K Cals energy annually and the post methanated effluents can provide 2,45,000 tons of Potassium, 12,500 tons of Nitrogen and 2,100 tons of Phosphorous annually and one year's effluents can meet the Potassium requirement of 1.55 million hectare land, Nitrogen requirement of 0.13 million hectares and Phosphorous requirement of 0.025 million hectare lands if two crops are taken in a year (*Yashpal 2015*).

Spent wash exhibits a very high level of Biological Oxygen Demand (40,000 to 65,000 mg/L) and Chemical Oxygen Demand (50,000 to 1,40,000 mg/L) with a high BOD: COD ratio. It is highly acidic with a pH of 3.0 to 4.5. The recalcitrant nature is due to the presence of melanoidins, caramel, polyphenols and a variety of sugar decomposition products such as anthocyanin, tannins and different xenobiotic compounds. The general composition of spent wash is as below:

General Composition of Spent wash		
1	Ash contents	25.51%.
2	Total Phosphorous as P ₂ O ₅	1.06%
3	Total Potassium as K ₂ O	27.89%
4	Total Calcium	26.58%
5	Total Magnesium	7.90%
6	Total Sulphur	23.28%
7	Zinc	Traces
8	Iron	Traces
9	Manganese	Traces
10	Alumina	0.05%

Spent wash Treatment

Various technology options are available for the treatment of distillery spent wash. They may include bio-methanation, and secondary treatment followed by irrigation, composting after or without bio-methanation.

We at Balrampur opted to go for Zero Liquid Discharge by using Incineration technology as per guideline of CPCB/UPPCB.

The spent wash from distillery is taken into receiving pit for settling of suspended solids. Then, spent wash feed into the Decanter for reduction of suspended solids present in the Spent Wash, it reduces 60 – 65% sludge from spent wash.

Thereafter, spent wash feed to multi effect evaporator plant (MEE) with 15% solid brix of spent wash. There are eight calendria in the plant. Five calendria are in series which work continuous process and one kept in standby. Other one calendria works as finisher and one kept in standby. Spent wash fed in MEE plant concentrate up to 60% with steam temperature 110°C and pressure 1 kg/cm².

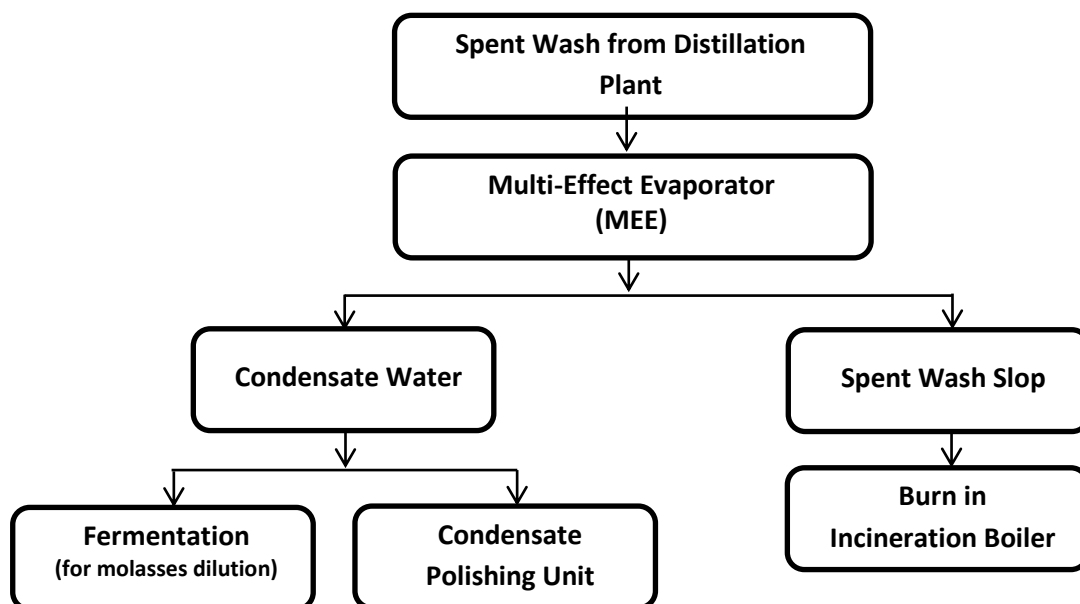
Condensate water of MEE Plant transfer to the Condensate Polishing Unit (CPU) for further treatment, CPU out let Condensate water is passed through R.O. Plant to maintain TDS. Further, the R.O. permeate water is being used in fermentation process and cooling tower as make-up water.

The final slop (Concentrated Spent Wash) of 60 brix from MEE plant fed into the Incineration Boiler with bagasse and entire Spent Wash Incinerate in the Incineration Boiler.

Adopting this technology we have achieved zero liquid discharge as per guideline of CPCB/UPPCB.

ZERO LIQUID DISCHARGE SYSTEM

SPENT WASH FLOW CHART



Multi Effect Evaporator Process

BCML has installed Multi Effect Evaporator System consists of five effect forced circulation type with a capacity of 1500 Cubic meter/day which had been supplied by M/s Disti Chemi Process Engineering Pvt. Ltd. Technical specification of Multi Effect Evaporator (M.E.E.) :-

S.No	Particulars	Unit	Plant Design Data	Plant Performance Data
1.0	Feed rate	Lit/hr	62500	45,000
2.0	Sp. Gravity		1.056	1.062
3.0	Feed rate	Kg/hr	66000	47,790
4.0	Feed solids	%	13.50	20.00
5.0	Concentrate solids	%	58 – 60	58 - 60
7.0	Concentrate rate	Kg/hr	14850	15,930
8.0	Water Evaporation in Evaporator	Kg/hr	51150	31,860
9.0	Steam consumption in 5 effects evap. @ 1.5 bar (g)	Kg/hr	6500	7,000
10.0	Water Evaporation in Finisher	Kg/hr	2000	2,000
11.0	Steam consumption in Finisher @1.5 bar (g)	Kg/hr	2200	2,200
12.0	Designing Detail			
	Cal 01		25.4 mm Φ x 7.5 mtr x 1338 No.	
	Cal 02		25.4 mm Φ x 7.5 mtr x 1338 No.	
	Cal 03		25.4 mm Φ x 7.5 mtr x 1338 No.	
	Cal 04		25.4 mm Φ x 7.5 mtr x 1096 No.	
	Cal 05 A		25.4 mm Φ x 7.5 mtr x 1096 No.	
	Cal 05 B		25.4 mm Φ x 7.5 mtr x 1096 No.	
	Fin 01		25.4 mm Φ x 7.5 mtr x 268 No.	
	Fin 02		25.4 mm Φ x 7.5 mtr x 268 No.	
	Condenser		19 mm Φ x 7.5 mtr x 1672 No. (4 Pass)	
	VS 01		1960 mm X 3000 mm	
	VS 02		2060 mm X 3000 mm	
	VS 03		2240 mm X 3000 mm	
	VS 04		2500 mm X 4000 mm	
	VS 05 A		2600 mm X 4000 mm	
	VS 05 B		2600 mm X 4000 mm	
	Finisher VS 01		940 mm X 3000 mm	
	Finisher VS 02		1220 mm X 3000 mm	

Note : Water evaporation rate is showing less due to initial feed solid percentage is high i.e. 20% instead of 13.5%.

Final slop (concentrated spent wash up to 58 – 60% solids) fed into incineration boiler along with supporting fuel i.e. bagasse and entire spent wash incinerate into incineration boiler. In compliance of CPCB / UPPCB directions, we have adopted the above technology for maintaining zero liquid discharge (ZLD).

Incineration Boiler

The slop of brix 58-60% from MEE Plant is taken into Incineration Boiler along with bagasse. The factory has installed Incineration Boiler consists of 40 TPH capacity, 44 kg/cm² (g), 400°C, 100% MCR slop + bagasse fired travelling grate boiler, which had been supplied by M/s ISGEC Heavy Engineer Ltd. Noida. The steam generated from Incineration Boiler is utilized in Turbine and thereafter consumed in Distillery Plant and MEE Plant.

Incineration boiler Stack height & dia is 70 Mtrs x 2 Mtrs respectively. It is equipped with online stack monitoring system, details are as under : -

Make	LKS
Model No	D10, TUV Approved
Web Site	www.nevcocpcb.com
Vendor	Nevco Engineers Pvt Ltd. New Delhi

TURBINE

The steam from Incineration boiler is taken into Turbine. The factory has installed 06 MW extraction condensing STG Set, which had been supplied & installed by M/s Maxwatt Turbines Pvt. Ltd., Bangalore. The electricity generated from TG Set is being consumed in home consumption and balance is being supply to grid (i.e. UP Power Corporation Ltd.)

D.G. SET

D.G. Set Details	Rating	Fuel	Units	Acoustic/ Canopy	Stack height
	750 KVA	HSD (Diesel)	01	DG Room	15 meter
	320 KVA	HSD (Diesel)	01	DG Room	15 meter

Condensate Polishing Unit (CPU) & R.O. Plant

During concentration of spent wash process condensate water comes out from MEE plant. Partly quantity of condensate water directly use for molasses dilution by adding enzyme and balance condensate water & Spent Lees from distillation plant transfer to Condensate Polishing Unit (CPU) for anaerobic & aerobic treatment.

CPU Outlet Water Parameters :

pH	:	7.0 – 7.5
COD	:	<130 ppm
BOD	:	<30 ppm
TDS	:	<450 ppm
TSS	:	<40 ppm
Silica	:	Not Available

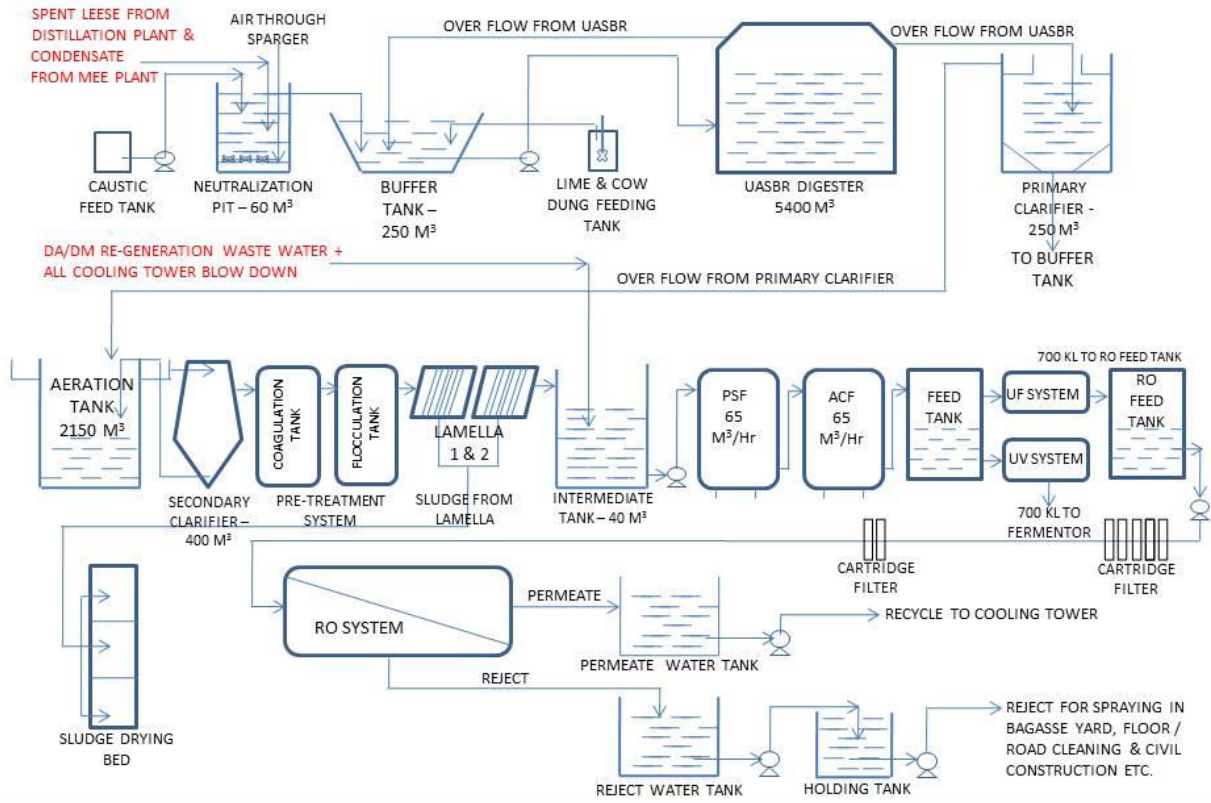
BCML has also installed R.O. Plant after treatment from C.P.U., condensate water mixed with DA plant charging + cooling tower blow down water passed through RO plant for further treatment of water. Permeate recovery of R.O. Plant is approximate 75%. Permeate water recycle as make-up water of cooling tower. Rejected water is being used in bagasse yard spraying, floor cleaning and civil construction.

R.O. Plant (Capacity : 65 M³/Hr) is consists of Feed Pump, RO Feed Tank, Pressure Sand Filter, Activated Carbon Filter, Micron Cartridge Filter, Acid Dosing System, Anti-scalant Dosing System, High Pressure Pump, RO Membrane System, RO Permeate Tank, RO Reject Tank with Pump.

RO Permeate Water Parameters :

pH	:	6.5 – 7.0
Total Dissolved Solids	:	< 40 ppm
Total Hardness as CaCO ₃	:	< 10 ppm (without softener)
Flow	:	52 M ³ /hr

FLOW DIAGRAM OF CONDENSATE POLISHING UNIT – 1400 KLD



M.E.E. Performance Report (copy of register data attached, Annexure-6)

Month	S/W Generation KL	Other Colored effluent KL	Feed to Evaporator . KL (MT)	Design Brix	Actual Brix Feed	Final Brix SLOP	Final SLOP Sp. Gravity	Slop Generation (MT)	Slop Cons. Boiler (MT)	Process Condensate Gen.(MT)	Feed to Slop Rati%	Design Evap.%	Actual Evap. %
April-2017	19468	7705	27173 (27882 MT)	13.5	20.0	58.0	1.25	8348	8348	19534	0.31	78.0	69.0
May-2017	27824	4434	32258 (33548 MT)	13.5	19.0	58.0	1.26	12291	12291	21257	0.38	78.0	62.0
June-2017	14513	3675	18188 (18927 MT)	13.5	19.5	58.0	1.26	6350	6350	12577	0.35	78.0	65.0

The Evaporation rate is less than design rate due to initial higher Brix.

Fuel balancing for 40 MT steam production through Incineration Boiler

Slop consumption: 13.50 MT/Hr @ Cal. Value – 1700 Kcal = 22950 Kg/hr steam
Bagasse consumption: 8.36 MT/Hr @ Cal.value -2200 Kcal = 18392 Kg/Hr steam
TOTAL = 39992 Kg/Hr

POTASH GRANULATION PLANT:

Two types of ashes are collected from the incineration boiler; one is bagasse ash which is black in colour and wet, while the other is Potash Rich ash which is Greyish-white in colour. This Potash Rich ash is very fine with no moisture and flies very fast and creates breathing problems to the neighbours. To overcome this problem and to utilize this valuable fertilizer, BCM decided to granulate the ash and installed a Granulation plant.

The capacity of the Granulation plant is 2MT per hour, thus gives about 45Mt of granules per day, 2 hour time is required to clean the plant daily.

The plant comprises of:

1. Gasification plant
2. Hot air generator
3. Raw material feeding silos
4. Granulator Drum
5. Hot air drum
6. Cooler drum
7. Graders
8. Hammer mills
9. Finished material bin
10. Bagging line

Gasification plant:

This plant produces Bio-gas. The Bio-gas is burnt in the Hot Air Generator, to dry the freshly produced Potash Granule. Press-mud briquettes at the rate of 350Kg per hour are used as fuel.

Hot air Generator:

Bio-gas burns here to produce high air temperature, range from 350 to 425degree C.

Raw material Feeding:

There are 3 silos, for ash, nutrients and for binders.

Potash Rich Ash comes pneumatically from Incineration boiler, to ash silo, while nutrients and binders are fed into other silos through belt conveyer.

Granulator Drum:

Required quantities of ASH, Nutrients and the binders are sent into the rotating Granulator drum, water is sprayed inside. With the rotation of the drum, mixture turns into granules.

Hot Air Drum:

fresh granules with 15 to 20% moisture travel from Granulator drum to Hot Air Drum for drying and tempering. Granules take about 4 minutes to travel through this drum. Two cyclones are connected to HAD to remove the hot moist air.

Cooler Drum:

Hot granules of 65 to 70 degree C travels to rotating air-cooled cooler drum through a conveyor. After traveling the granules are ready. These are passed through a grader for uniform size, from grader to finished goods bin and finally packing.

Finished Product:

It is greyish-black in colour, moisture 3 to 4%, and 2 to 4mm in size, with K₂O value range between 16 to 20%.

Potash Rich Ash: This ash comes out from the boiler is dry and contains high amount of water soluble potash as K₂O:

Analysis report of Potash Ash		
Date	Samples. Time	Potash (%)
Jan-18		
01/12/18	10.00 am	27.65
	6.00 pm	27.05
	4.00 am	26.5
02/12/18	10.00 am	27.6
	8.00 pm	27.65
	3.00 am	25.05
03/12/18	10.00 am	24.5
	6.00 pm	27.6
	2.00 am	22.1
04/12/18	10.00 am	20.3
	6.00 pm	21.9
	4.00 am	28.3
05/12/18	10.00 am	28.8
	5.00 pm	27.35
	3.00 am	27.05

The chemical analysis of the Potash-granules:

Analysis report of Potash Ash Granules		
Date	Smp. Time	Potash (%)
Jan-18		
01/12/18	10.00 am	17.65
	6.00 pm	17.05
	4.00 am	16.5
02/12/18	10.00 am	17.6
	8.00 pm	17.65
	3.00 am	17.05
03/12/18	10.00 am	16.5
	6.00 pm	17.6
	2.00 am	19.0
04/12/18	10.00 am	20.3
	6.00 pm	20.9
	4.00 am	18.3
05/12/18	10.00 am	18.8
	5.00 pm	17.35
	3.00 am	17.05

Agriculture Ministry has placed the Potash under the Fertilizer Control Order under “Potash derived from Molasses” and the specifications are as below:

Moisture percentage	5.0
Water soluble Potassium (asK ₂ O) percent	14.5

Balrampur Chini supplies the product to M/s IFFCO eBazaar Ltd, and own growers.

Potash derived from molasses – An indigenous alternative to import of Muriate of Potash (MoP)

Import of Muriate of Potash (MoP):

Demand for Muriate of Potash (MoP) is fulfilled entirely through imports in India. In 2015-16, actual consumption is 24.7 lakh MT. Subsidy outgo of approx. Rs 2297 cr (@ Rs 9300/MT) in 2015-16 is reimbursed to marketing entities. Since, there is no indigenous source for MoP or its alternative, dependence on imports likely to continue for long. MoP contains 60% potash. Accordingly, 14.8 lakh MT potash nutrient was applied to soil in 2015-16. Growth in demand is reported to be more than 4% per annum in last 3 years.

Potash derived from molasses (indigenous) - An alternative to MoP:

Production of 1 lt of alcohol results in 0.356 Kg Potash ash. Accordingly, all 285 distilleries in India producing 27000 lakh lt of alcohol annually will result in production of 9.4 lakh MT Potash ash. Considering minimum 20% potash in ash, total potash nutrient supply potential works out to 1.89 lakh MT. Thus Potash ash contains 1.89 lakh MT potash nutrients which could be used directly for agriculture purposes.

Savings in foreign exchange:

1.89 lakh MT potash nutrient will directly reduce the import of MoP by 3.2 Lakh MT. Savings on account of foreign exchange will be to the tune of Approx. Rs 500 cr per annum.

Potash ash use in agriculture: Use of potash ash in crop production is already in practice. Potash ash is soluble in water and can be applied directly in powder form. However, powder form is health hazardous hence it can be granulated for ease of application. Trials conducted have shown results at par with MoP in equivalent nutrient terms. Since potash ash also contains carbon, its use in long run will improve soil health thus establishing superiority over MoP.

Proposal:

Potash ash produced indigenously, to be promoted as an alternative to MoP in India. Subsidy parity is provided to Potash ash in relation to MoP. This is required to position potash ash at par with MoP.

Potash derived from molasses in ash or granulated form be classified as Organic Potash in FCO with Potassic contents as 14.5% as already defined under FCO.

- 1) Potash ash to be promoted as part of soil health improvement program.
- 2) Recycling the farm produce for improvement of soil health is environment friendly approach. It's a win-win situation for all stakeholders.

Thanks:

I would like to express my sincere thanks to Sh. Vivek Saraogi, Managing Director of Balrampur Chini Mills, for encouraging me and rendered every help to formulate the project and finally to execute a commercial project.

