तेल उद्योग सुरक्षा निदेशालय
Oil Industry Safety Directorate
ISO 9001:2015 certified

सुरक्षा संवाद
Suraksha Samwad

An opportunity to learn from mistakes....

Disclaimer

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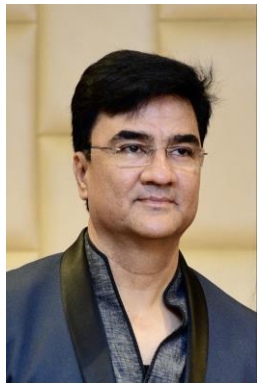

Sh. Sanjeev Kumar Mohan
General Manager (Production)

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Education Qualification: B. E. Mechanical Engineering from Karnataka University, Bijapur, MBA- Marketing IGNOU, New Delhi

Worked in Operations in different Assets and Plants of ONGC. Has experience in carrying out Surface Team Operations, Process Plant Operations, Turnaround, Commissioning of Phase 1 & 2 at CPF Gandhar. Currently, he is Area Manager for SRU CFU & DPD of ONGC , Hazira Plant. He has experience of 31 years.

He has conducted several Accident Investigations.

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PRESENTATION

ON

REVAMPING OF SULPHUR RECOVERY UNIT, ONGC, HAZIRA PLANT

PRESENTED BY: SANJEEV MOHAN, GM(P)

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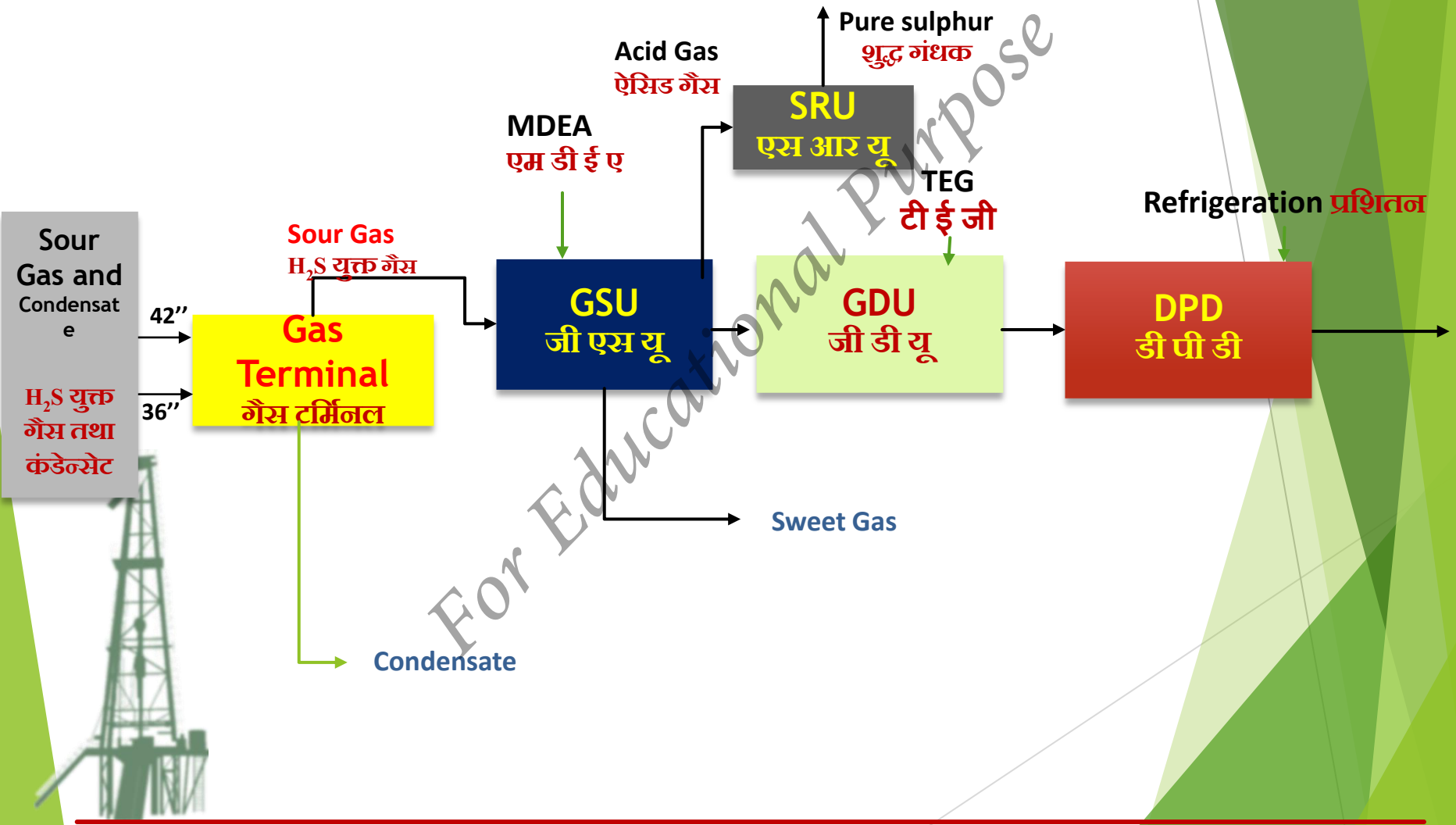
Overview of a typical Gas Sweetening Plant



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OVERALL BLOCK DIAGRAM OF GSU / SRU

BLOCK DIAGRAM - GSU / SRU

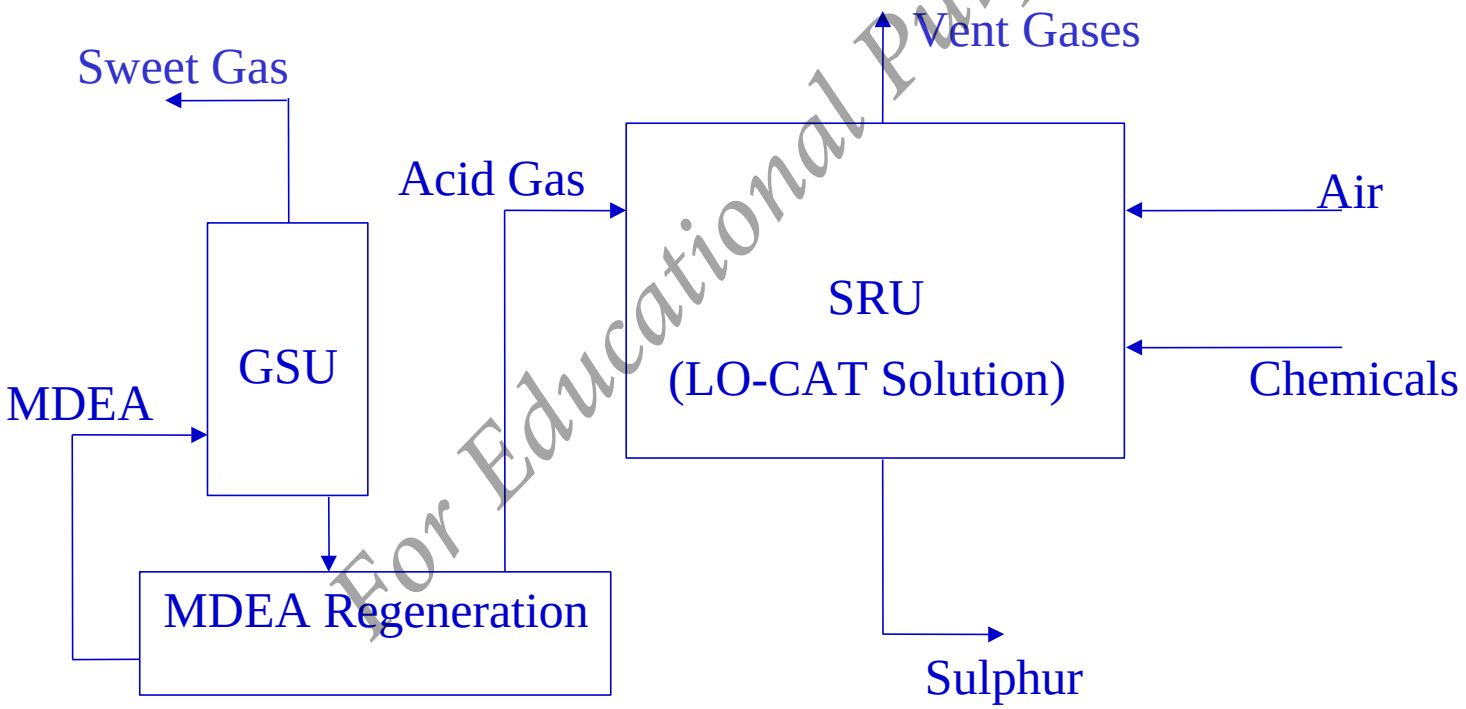

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Fig. 1.1

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Sulphur Recovery Unit: Environmental Protection
गंधक निष्कर्षण इकाई: पर्यावरण संरक्षण

A responsible environmental initiative since 1988….
1988 से एक जिम्मेदार पर्यावरणीय पहल….

- Purpose of SRU is to process acid gas to nuetralise H_2S and reduce SO_2 emission
- एस आर यू का प्रायोजन ऐसिड गॅस मे सम्मेलित H_2S पर प्रक्रिया कर पर्यावरण मापदंडो पर खरा उतरते हुए SO_2 के उत्सर्जन को कम करने के लिए किया गया है

- H_2S is absorbed from sour gas with MDEA in GSU
- जी एस यू मे एम डी ई ए के माध्यम से H_2Sआवशोषित की जाती है

- Regeneration of MDEA releases absorbed Acid Gas
- एम डी ई ए के पुनर्जनन के दौरान ऐसिड गैस निकलती है

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TYPICAL GAS IN AND OUT SPECS(V/V)
गॅस प्रवेश तथा निकास के विनिर्देश (आयतन)

	Design Inlet परिकल्पित प्रवेश	Actual Inlet वास्तविक प्रवेश	Vent Gas गॅस निकास
H_2S	3000—52000 PPM/पी पी एम	4000-11000 PPM/पी पी एम	< 30 PPM/पी पी एम
CO_2	85.3%	95-98 %	35-40 %
H_20	8.5%	3-8%	9-16%
HC	1%	1-1.5%	0.3-0.4%
N_2	-	-	39-41%
O_2	-	-	9-11%

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SRU PROCESS BACKGROUND
एस आर यू प्रोसेस

LOCAT : "LIQUID PHASE OXIDATION BY CATALYST" PROCESS IS USED IN SRU.

- 1964: CHELATED IRON PROCESS (CIP) : DEVELOPED BY HUMPHREY & GLASSGOW, UK.
- 1970: LOCAT PROCESS : DEVELOPED BY THOMSON OF AIR RESOURCE INC., USA.
- LICENSOR- MERICHEM, USA. (FORMERLY KNOWN ARI TECHNOLOGIES, USA).

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INDIGENOUS EFFORT TO DEVELOP LOCAT

DEVELOPMENT OF CATSOL (SUPPLIER: GNFC) AS AN ALTERNATIVE TO LOCAT :

- ONGC PROVIDED INFRASTRUCTURAL & MAN-POWER FACILITIES AND EXPERTISE TO CONDUCT A COMMERCIAL-TRIAL OF INDIGENOUSLY DEVELOPED CATALYST SOLUTION (BY M/S **GNFC** & EIL JOINT VENTURE) FOR PROCESSING ACID GAS IN SRU.

- THIS WAS UNDER PATSER PROJECT OF DSIR, GOVT OF INDIA, MONITORED UNDER THE CHAIRMANSHIP OF ED, MRBC.

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DIFFERENCE FROM CLAUS PROCESS

- **Claus process is typically used for acid gas feed having greater than 50% H2S. Low H2S concentration affects flame stability in the burner.**

- **In liquid redox as the H2S concentration is very low, it offers thorough conversion of H2S directly to Sulphur using intimate contact with catalyst solution.**

- **Liquid redox process talks place at ambient temperature**

- **Sulphur is not liquefied in liquid redox process. Sulphur is obtained in form of slurry (i.e. solid Sulphur particles in catalyst solution.)**

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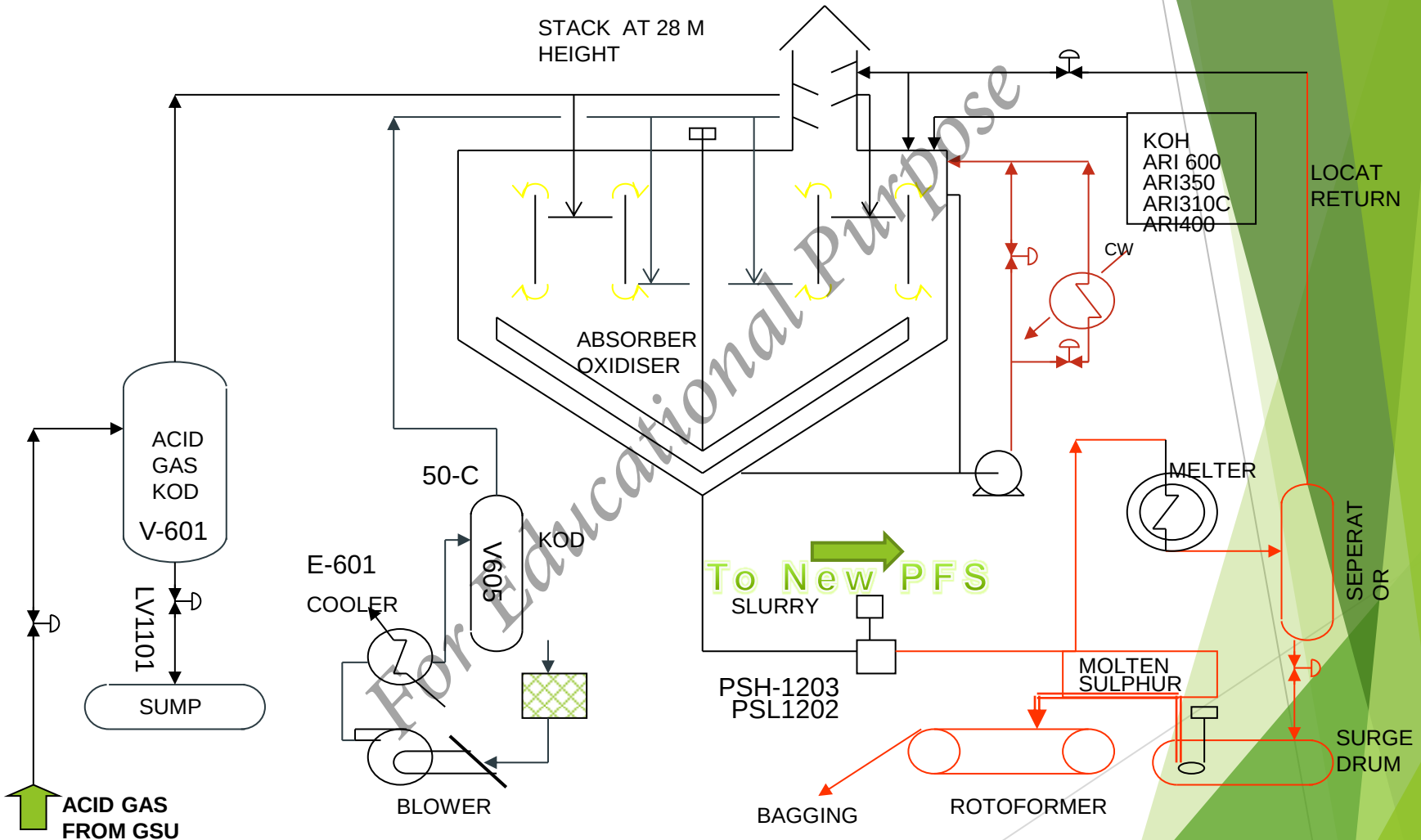
SRU BLOCK DIAGRAM
एस आर यू ब्लॉक डायग्राम



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SRU

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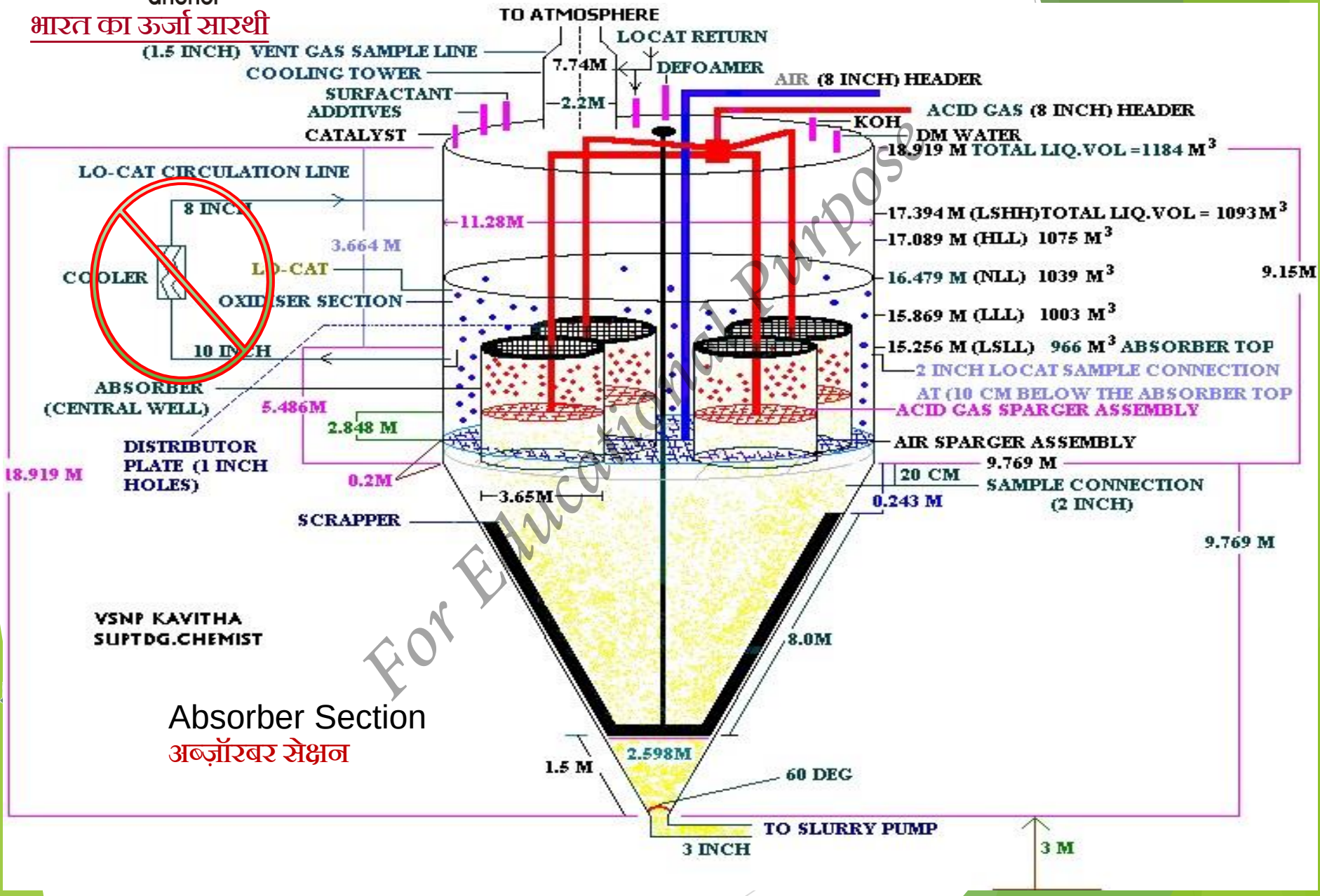
SRU Absorber Internals



Absorber Section
अब्ज़ॉरबर सेक्षन

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SRU PROCESS
एस आर यू प्रोसेस

The LOCAT unit utilizes differential density between two aerated liquid phases to circulate solution from oxidizer section to absorber section of vessel.

The solution absorbs H_2S and small amount of CO_2 and returns to oxidizer. Air is introduced in oxidizer section whose oxygen is absorbed in solution. This oxygen regenerates catalyst.

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Basic Chemical Reactions
बुनियादी रासायनिक प्रतिक्रिया

Absorption reaction/ अब्सॉर्प्शन प्रतिक्रिया

$H_2S+H_2O+2Fe^{+++} \rightarrow S + 2\ Fe^{++} + H_2O + 2H$

Oxidation Reaction/ ऑक्सीडेशन प्रतिक्रिया

$1/2\ O_2+H_2O+2Fe^{++} \rightarrow 2Fe^{+++} + 2OH$

Overall Reaction / समग्र प्रतिक्रिया

$H_2S+1/2\ O_2 \rightarrow H_2O+S$

Side Reactions

$2H_2S + 2O_2$ ------→ $2H^+ + H_2O + S_2O_3^-$ (thiosulphates)

$CO_2 + H_2O$-----→ H_2CO_3--→$H^+ + HCO_3^-$ (bicarbonates)

HCO_3^- ----→$H^+ + CO_3^-$ (carbonates) This H^+ reduces pH so KOH is added

Salts produced in side reaction are controlled by blow down

सह प्रतिक्रियाओं में उत्पदित अन्य क्षार ब्लो डाउन द्वारा नियंत्रण किये जाते है

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SRU Process Variables

- The Lo-Cat solution temperature in 61-V-602 should be kept between 16^0C and 50^0C. Excessive thiosulphate production will result *if* the temperature is allowed to increase beyond 50^OC.
- Variables that affect absorption and oxidation efficiency are:
  - pH
  - Gas rate
  - H_2S concentration
  - Lo-cat solution concentration rate / Iron concentration
  - Oxidizer air rate
  - Lo-cat solution temperature
- The pH of the circulating solution should be kept between 7.5 and 8.5 by the rate of addition of potassium hydroxide (KOH). Operating at the high end of the pH range has the following effects:
  - Maximum H_2S absorption
  - Maximum catalyst life by –
    - Reduced biological activity
    - Reduced catalyst oxidation rate
  - Increased chemical costs by –
    - Increased Thiosulfate ($K_2S_2O_3$) production

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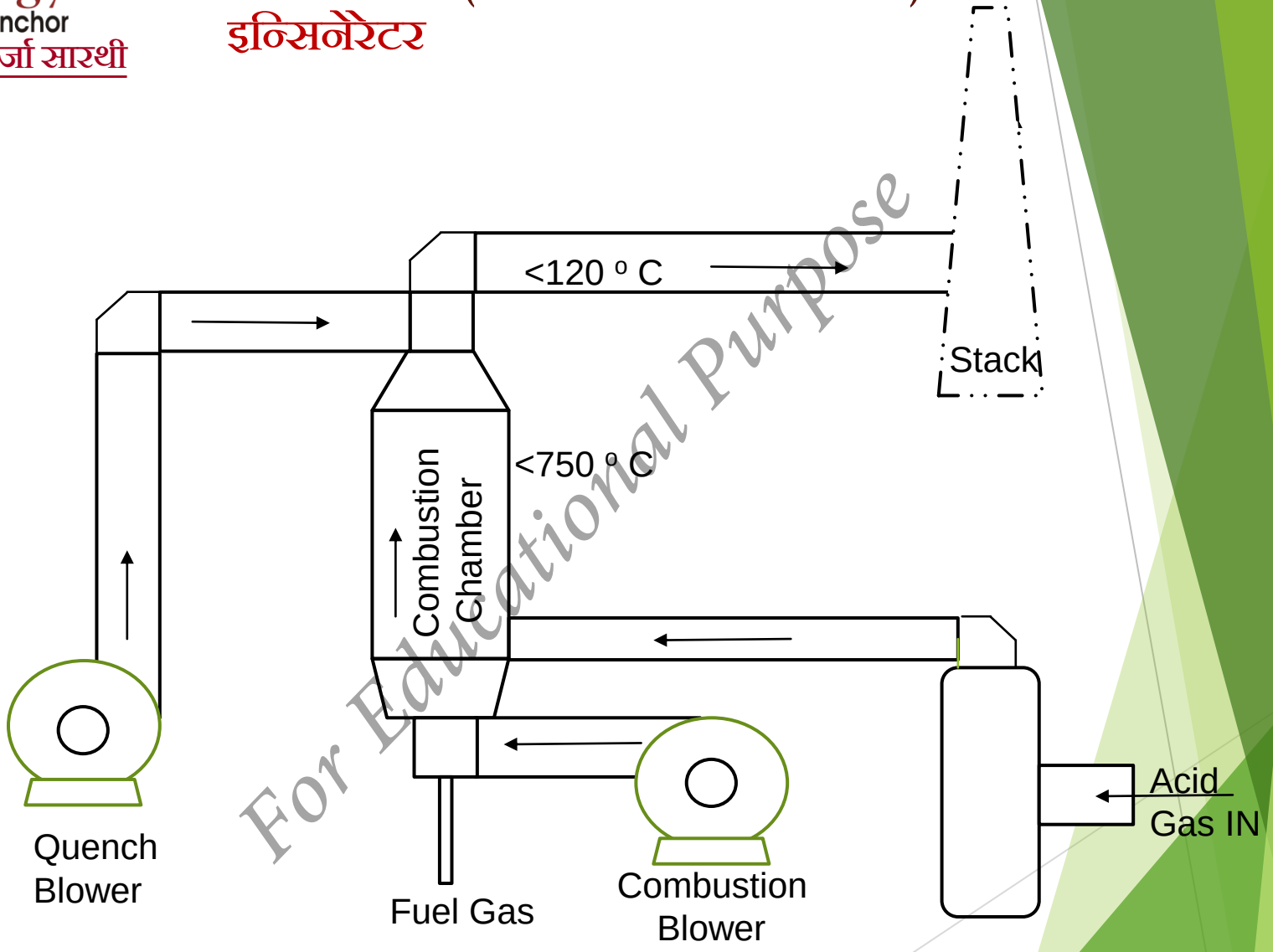
Incinerator (EMERGENCY VENTING)
इन्सिनेरेटर



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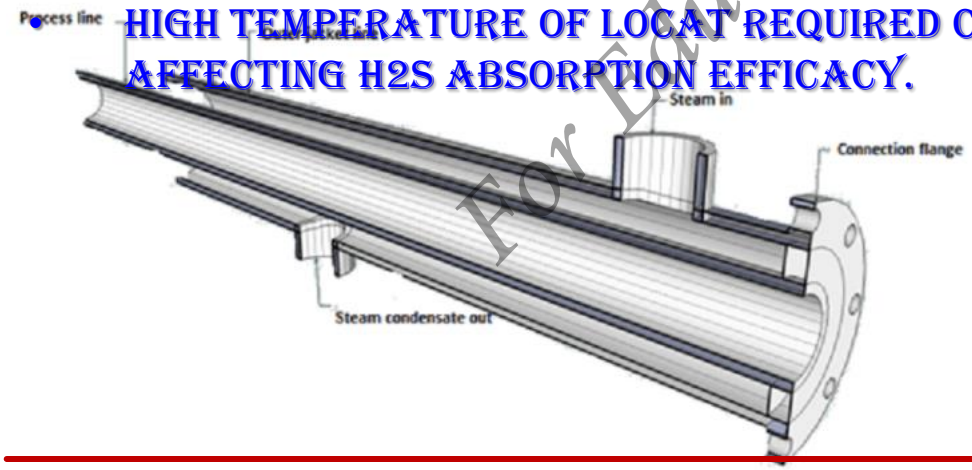
Highlights of technical issues with original design

SULPHUR MELTING SYSTEM; CAUSE & EFFECT

- MOLTEN SULPHUR PRONE TO COAGULATION/SOLIDIFYING IN PIPELINES & EQUIPMENT.
- SUBTLE CHANGE IN AMBIENT TEMPERATURES VARIED THE VISCOSITY OF THE FLOWING SULPHUR CAUSING REGULAR CHOKING OF THE SECTIONS.
- SUSCEPTIBLE TO STEAM LEAKAGE REPAIR REQUIRED TO BE TAKEN UP AS ROUTINE.
- THE STEAM JACKETED PIPELINES WERE HIGHLY EXPENSIVE TO MAINTAIN & REPLACE.
- MONITORING MOLTEN SULPHUR LEVELS WAS CHALLENGING & REQUIRED RADIOACTIVE NUCLEONIC LTS WITH HALF LIFE OF 30 YEARS.
- RIGHT FROM MELTING TO PALLETIZING OF THE SULPHUR REQUIRED CONTINUOUS MAINTENANCE & EXTENDED SHUT-DOWNS CAUSING OPERATIONAL LIMITATIONS.
- HIGH TEMPERATURE OF LOCAT REQUIRED COOLING MANAGEMENT & ALSO AFFECTING H2S ABSORPTION EFFICACY.



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Vertical Pressure Filter-An Alternative System

- Thorough separation of sulphur from slurry achieved by squeezing operation using high pressure water and tight weave filter cloth.
- Filter takes slurry feed (Sulphur concn-5-15 wt%) from absorber bottom pumps and the product is in the form of solid Sulphur cakes having < 10 wt% (max) moisture content.
- Filter has in-built provision for cake wash, cloth wash and automatic cake discharge through rolling plate mechanism.
- Filtration system will not involve any molten section so that high temperature problems can be avoided (fire problem due to pyrophoric sulphur)
- Smooth evacuation of sulphur from Reactor will maintain the process parameter .
- Only two filter(1 working + 1 standby) is required for all 6 Train.
- In case, slurry concn. is low (<~5wt%), it is first concentrated using membrane system and then routed to the pressure filter.

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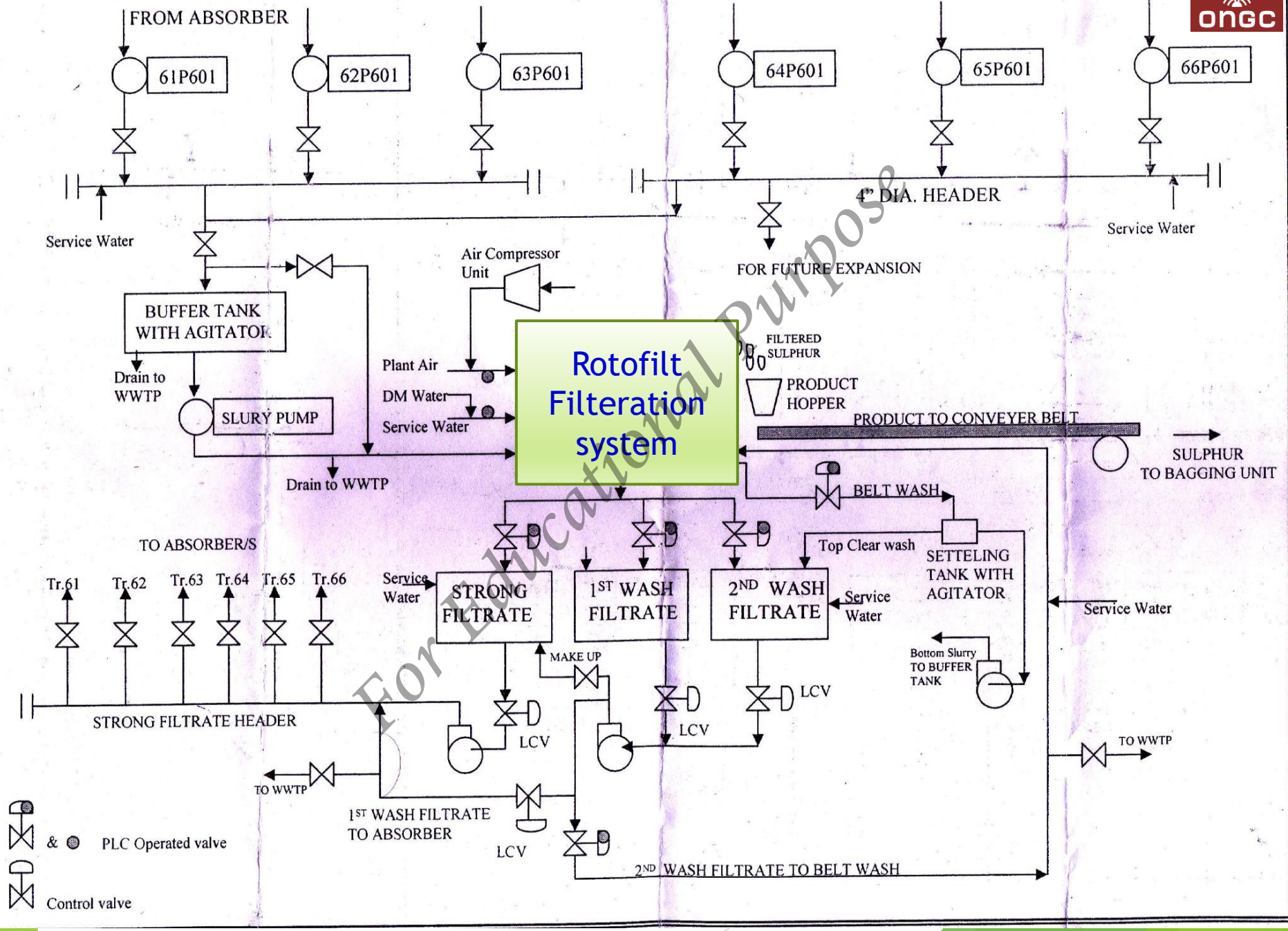
NEW PFS SCHEMATIC



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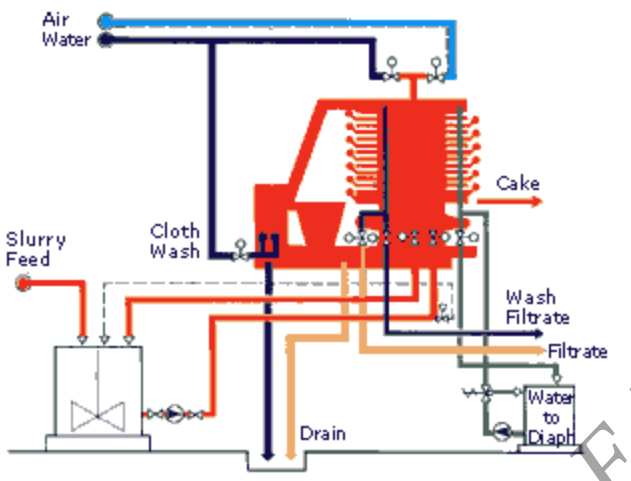

The Automatic Pressure Filter was introduced as the drying cost of the product day by day was increasing by conventional means of filtration like vacuum filters, filter presses, Gravity Filters etc. Higher moisture content of the cake leads to high drying cost as well as Conveying cost hence requirement of extremely dry cake was inevitable. The separation results are so encouraging that it has gained popularity in all type of process industries and replacing conventional separation equipments. As also filtration area has increased and presently Large Machines with up to 75 m2 handling 60-75 TPH of Concentrates.

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Operation of Automatic Vertical Pressure Filter

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- Step – 1 : Feeding
- Step – 2 : Pre-Squeezing
- Step – 3 : Cake Washing (Optional)
- Step – 4 : Final Squeezing (Optional)
- Step – 5 : Air Blowing
- Step – 6 : Cake Discharge

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STEP - 1

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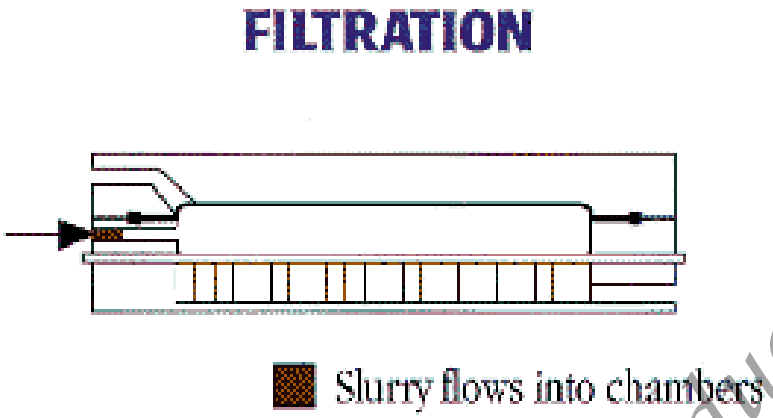

Initial Filtration Process Takes Place

With the push of one button, the operator initiates filtration. Filter plates closes, creating separate separation chambers. Slurry is pumped simultaneously into all chambers and cake is formed as filtrate begins to flow.

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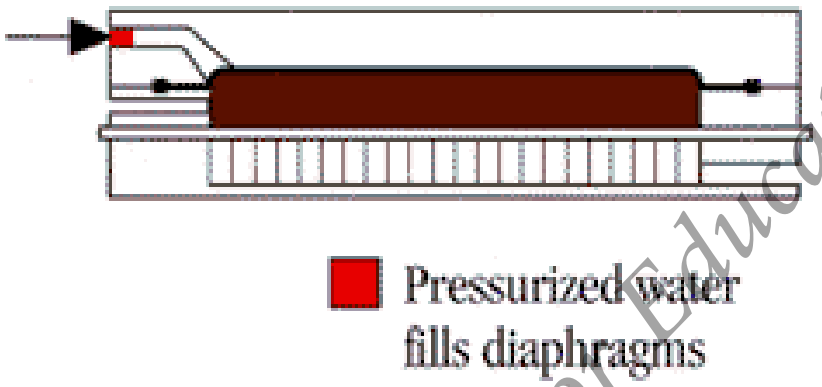
1ST SQUEEZE



Pre-Squeezing Produces More Filtrate Flow

High pressure water automatically fills all Diaphragms in all chambers, Squeezing the cake to produce even more filtrate flow. High Pressure allows use of tight weave cloth which increases filtration efficiency.

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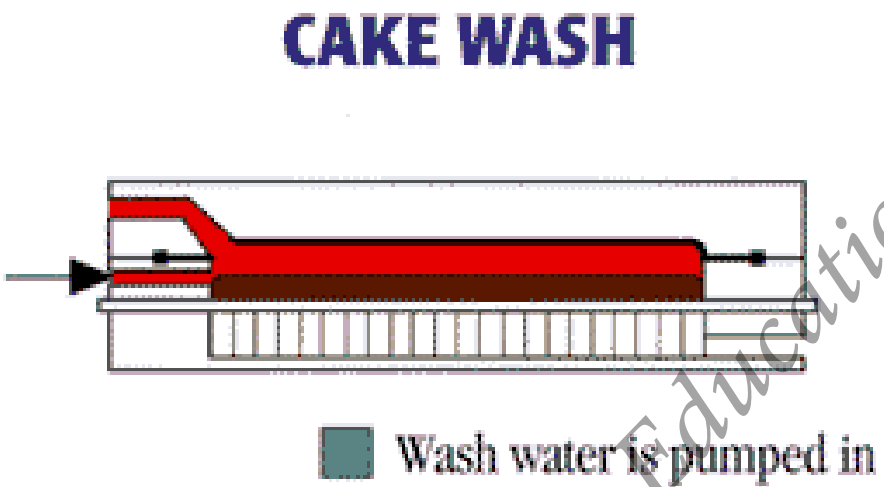

Automatic Cake Washing

All Diaphragms are drained of high pressure water and wash water is pumped in over the cake in all chambers. Because cake lies flat and un cracked, wash water is distributed evenly for uniform cake washing and purity.

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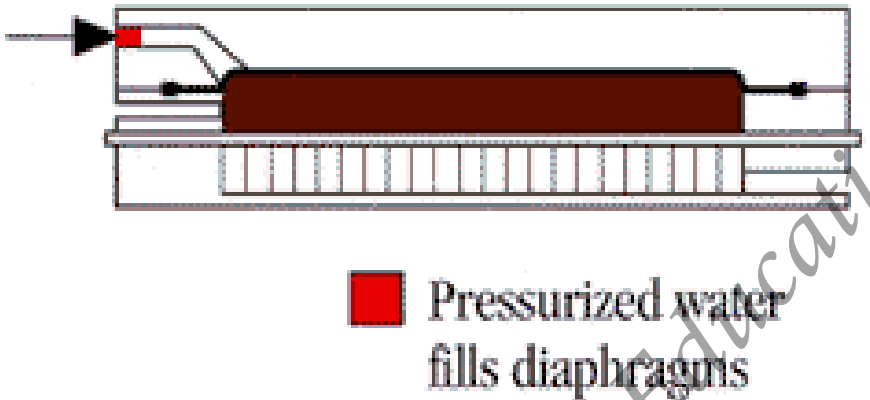

Final Squeezing

High Pressure Water again fills all Diaphragms automatically. It squeezes the wash water through the cake, Producing almost total displacement of wash, Resulting in maximum wash efficiency.

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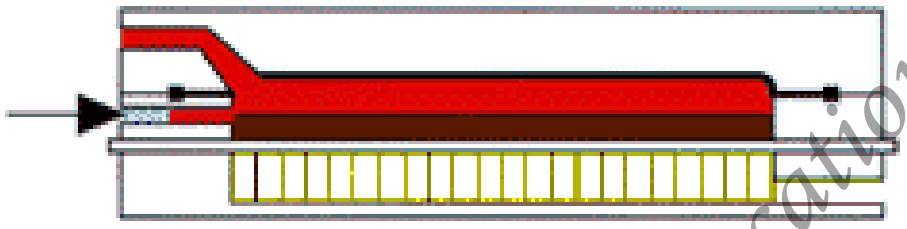
AIR BLOW DRY



Compressed air is blown into chambers

Air Blowing Dries Cake Further

Compressed Air is blown through cake in all the chambers simultaneously, To reduce cake moisture even further. By controlling length of Air Blowing period, user can control final cake dryness.

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Step- 6

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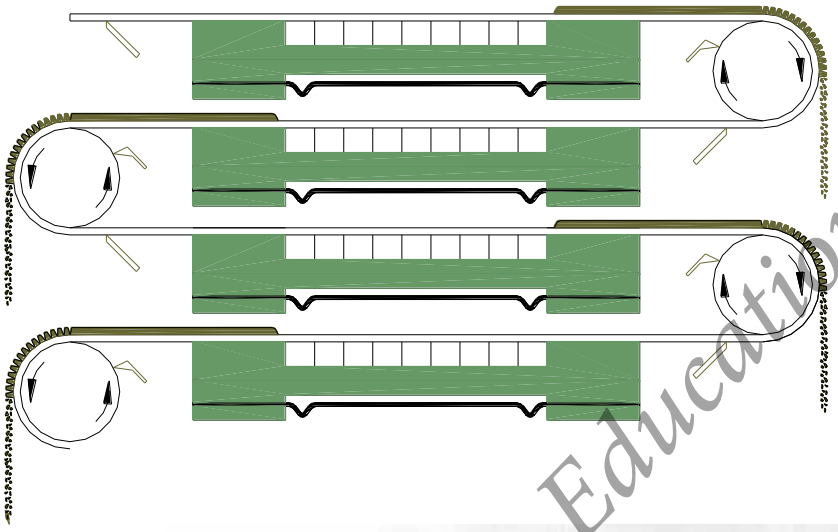

Automatic Cake Discharge

All filter plates opens automatically and the filter cloth advances through the unit and providing 100% cake discharge with no operator involvement. Filter cloth is washed automatically.

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Overview of Operational and Safety Aspects of Pressure Filter and Membrane System

- Pressure Filter operation is a batch type process having a number of operations in sequence such as:
  - Feeding
  - Pre-squeezing
  - Cake wash
  - Final squeezing
  - Air drying (optional)
  - Cake discharge
- Both filter operation and membrane operation are controlled by a dedicated a timer based PLC. Timer shall be optimized based on plant trial runs and shall be operator adjustable. Provision for manual over-ride also provided.
- All pumps provided with trip interlocks based on low level in respective tanks along with alarm in control room.
- Interlock to cut-off acid gas feed to SRU is provided on high concentration of H2S gas vent to atm. (very rare and unlikely event)

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New Pressure Filtration

AVPF Animated Video

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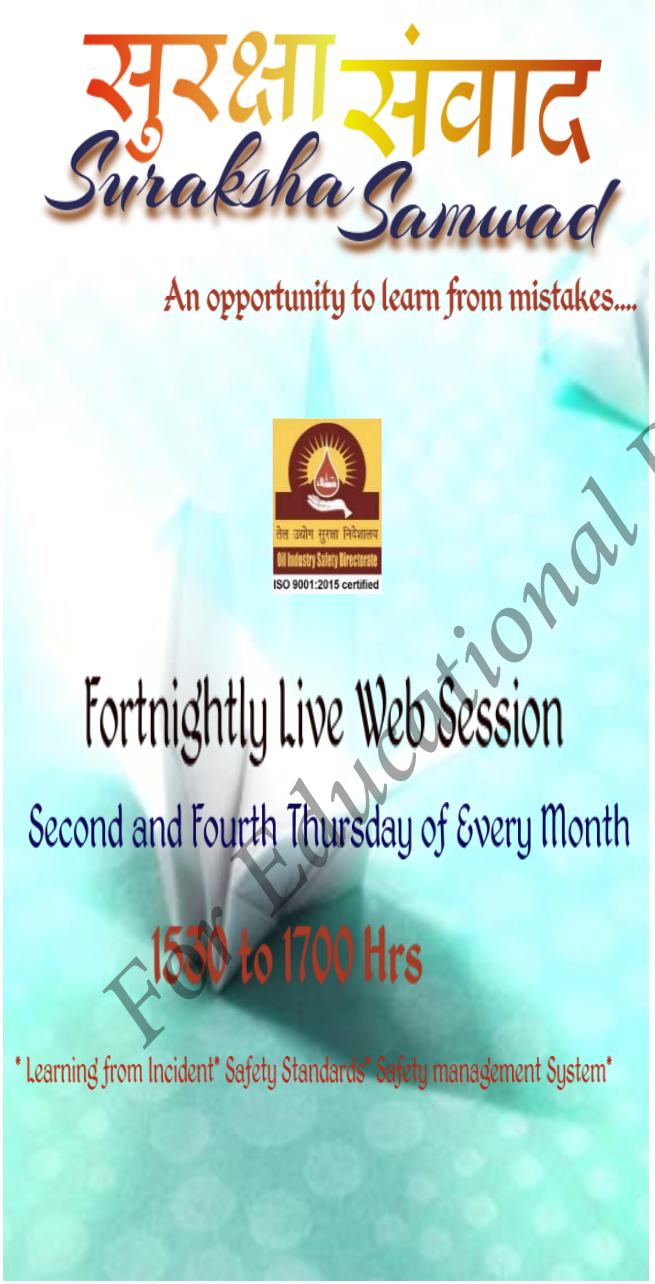

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आपके अविभाजित ध्यान के लिए धन्यवाद!!