Indian Institute of Technology, Bombay
Department of Chemical Engineering

Overview of Indian Chemical Industry (CL 308)

Final Report

UPL Ltd.

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About UPL Ltd.

- UPL was established by the name of United Phosphorus Limited in 1969. It was renamed as UPL Limited in 2013.
- It is an Indian multinational company having its business in Agrochemicals, industrial chemicals, chemical intermediates, specialty chemicals, and crop protection solutions.
- The company is present in 138+ countries with a revenue of INR 46,240.00 Cr in financial year 2022.
- UPL has a total of 13000+ product registrations, 1500+ patents, 1500+ product formulations.
- The company operated 42 manufacturing sites and 30 R&D facilities worldwide. In India, the company has 15 plants involved in 166 products.

Portfolio of products

UPL follows a holistic portfolio of modern agricultural solutions. The portfolio is divided into 5 major sectors:-

Conventional Crop Protection Solutions: Localised approach with an integrated, best-in-class formulation approach and technology help fulfil our objective of developing mixtures and combinations that are highly flexible and address farmer pain points effectively.

BioSolutions: Unique BioSolutions portfolio crafted to promote crop stimulation, nutrition and sustainable crop protection, which ensures increased crop yields. This also includes establishing and enhancing a sustainable agricultural system around the reduction of soil degradation and water conservation.

Seeds: Deliver world-class seeds by integrating the most advanced techniques in conventional plant breeding with biotechnology

Post-Harvest: Provide a variety of post-harvest solutions, which include coatings, cleaners, sanitisers, fungicides, growth regulators and anti-scald

Physical and Digital Services: Digital platform nurture.farm connects the ag ecosystem through digital technologies to provide services, products and solutions to the farmers for sustainable farming.

Financial data of UPL Ltd.

Revenues (INR Cr)	46,240
Ebitda (INR Cr)	10,165
Cash From Operations (INR Cr)	6,496
Ebitda Margin (%)	22.0
Profit After Tax (INR Cr)	4,627
Eps (INR/per share)	45.87
Net Worth (INR Cr)	24,662
Fixed Assets (INR Cr)	19,538
Net Debt To Ebitda (X)	1.9
Return On Capital Employed (%)	15.6

Globe overview of the business

UPL Ltd. is present in 138+ countries with

Geographical analysis of UPL’s business:-

Region	Revenue (in Cr)(INR)	No. of Products	No. of Plants
India	5,687	166	15
North America	7,808	198	1
Latin America	18,039	535	9
Europe	6,893	465	10
Rest of World	7,812	876	7

Company’s contribution towards sustainability

“Sustainability is to maintain a healthy environment as well as business. It means to ensure our people, the community we are surrounded by and the environment are well looked after. At UPL, sustainability is a holistic approach to doing good business for progress, prosperity, people and the planet.” - Team UPL

The company’s sustainability goals are driven by the following parameters

- Environmental Sustainability: UPL is constantly working to reduce environmental footprint as environmental care has been a part of our core philosophy since inception and is practised in our daily business across the value chain.

- Economic Sustainability & Growth Strategy: UPL is committed to perform consistently on all economic parameters. With powerful steps we aim to enhance farm viability and improve the economic prosperity of farmers, distributors, retailers and partners across the globe, increasing shareholder value.

- People Development & Human Rights: Our world-class crop and seed solutions have their beginnings in our people. We believe in considering everything we do through the lens of how it will affect them, and our organisational culture – always prioritising wellness, learning, fairness, and inclusivity.

- Health, Safety & Environment Policy: The safety of our employees, both permanent and contractual, is very important to us. All efforts are taken to ensure that the environment they are working is safe and injury free.

- Social Responsibility: *“Caring enough is the commitment to ‘Do things better’ – not just for the business but for the world at large. We undertake multiple initiatives to strengthen communities.”* - Mrs. Sandra Shroff, Vice Chairman, UPL

The major goals of sustainable development that the company wants to achieve are:-

- Goal 1: Reduce Environmental Footprint

- Goal 2: Enhance World Food Security

- Goal 3: Enhance Sustainable Sourcing

- Goal 4: Strengthen Community Wellbeing

UPL’s contribution Corporate Social Responsibility

Let's look at few of the many campaigns that UPL runs for the betterment of the society

One Billion Hearts: A Program to Improve Cardiovascular Health in Rural Côte d'Ivoir (West Africa)

UPL Ltd. has partnered with The Heart Fund, a global healthcare non-profit organisation to provide universal access to cardiovascular health for 1 billion people by 2030. UPL’s support in the form of a 5-year partnership will enhance the capability of the organisation to serve the traditionally underserved rural farming communities. The program which was initiated 2 years back has achieved many milestones in cardiovascular screening, preventive activities and health education in remote locations.

Progress in the past two years:-

- 18 campaigns were organised across 36 villages
- 8,300 kms travelled
- 50,000+ villagers made aware through print campaigns
- 6,056 consultations of cardiology
- 303 average daily consultations
- 692 ECG and 291 echographs
- 30,000+ people made aware of CV risk factors

Together with humanity: UPL's response during the COVID-19 pandemic

UPL's core value of being "Always Human" extends to our global stakeholders and to communities which sustain them. During these unprecedented times, UPL as a globally responsible and committed company, faced the pandemic challenges head on, reaching out to all our stakeholders worldwide- India, Sri Lanka, Indonesia, Vietnam, Cambodia, Brazil, Costa Rica, Ivory Coast, Cuba, USA, Canada, France, England, among others.

UPL's efforts in 2020:-

- 1.15 Million Litres sanitizing solutions provided worldwide
- 50K+ Litres of hand sanitizers provided across the globe
- Disinfected public areas with 5.3 Million Litres of Sodium Hypochlorite Solution
- 3,00,000+ face masks distributed across the globe
- 700+ villages in India sanitized through our sprayers
- Supplied USD 3.3 Million worth of Personal Protective Equipment (PPEs)
- Contributed INR 1 Crore (USD 135,000) to the Mumbai Police Foundation
- INR 75 Crore (nearly USD 10 Million) given to PM Cares Fund in India
- 100,000 Thai Bath donated towards relief efforts
- USD 0.5 Million worth Covid testing kits provided at Sao Paolo, Brazil
- 15,000+ food packets prepared and distributed for migrant workers in India
- 7,000+ farmers connected with 2,500 buyers to help the farmers in India

Overview of UPL Ltd. unit 5 Jhagadia

- Unit 5 was started in 1994 and is spread across an area of 219 Acres.
- This unit deals with 7 herbicides, 7 fungicides, 13 speciality chemicals and 3 intermediates along with 4 NABL credited quality assurance labs.
- This unit has an inhouse 29W captive power plant which is able to supply ~60% of the total energy requirement.
- They are also planning to switch to biomass as the main energy source in the coming future. The required biomass is ~3 lakh MT, and their supply that can be generated through nearby area is ~9 lakh MT
- The course on wheels team visited 2 plants in unit 5 which were Carbon Disulphide (CS2) and Mancozeb.

Carbon disulphide plant

- This plant was commissioned in 2013 having a capacity of 140 TPD and is currently operating at 80 TPD.
- This plant has recorded zero process incidents since commission.
- This plant operates on DCS with the technology providers being AkzoNobel.

Carbon Disulphide is a widely used solvent in the chemical industry. In this project, we focus on the process used by the UPL company to generate this product. There are 2 major sections:

1) CS_2 section: $CH_4 + 4S \rightarrow CS_2 + 2H_2S$
2) H_2S section: $H_2S + 1.5O_2 \rightarrow SO_2 + H_2O$ and $2H_2S + SO_2 \rightarrow 3S + 2H_2O$

The CS_2 section is that part of the plant where CS2 is actually made. H_2S being a byproduct is treated further to convert back to Sulphur, which is one of the raw materials used. This way, we require less Sulphur per kg CS_2 produced. In the process, there is a lot of recycling. We deal with that at the end of this abstract. Let's ignore all recycle streams for now and deal with a single pass production.

CS_2 Section

- Methane from natural gas and Molten Sulphur are fed to a plug flow reactor where it gets oxidised to CS2 and H2S. There is a very high (~99%) conversion achieved in the first step, but there is still some sulphur remaining.
- So, the exiting stream is cooled down below melting point of sulphur and it is separated in a Gas Liquid Separator.
- There are few more steps of removing this sulphur like stripping using CS2 to remove entrained Sulphur droplets and a purifier (Distillation column).
- The stream from the stripper enters another distillation column called the stabiliser where H2S is removed from CS2
- All this H2S along with H2S from various GL separators is clubbed and sent to H2S section for sulphur recovery

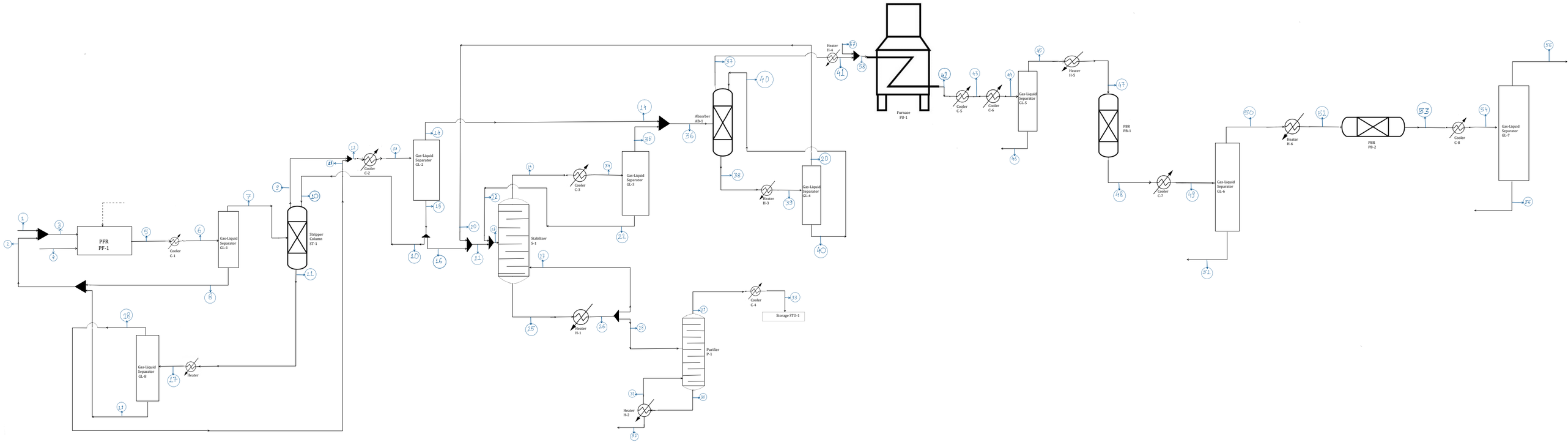
H2S Section

- First, any entrained CS2 in the H2S is removed using a absorption-desorption system using Pella oil. All the CS2 collected is sent back for purification
- The H2S gas is burnt using air (we have used O2 in our simulation for simplicity)
- There is a series of coolers which bring down the temperature of the stream to 493K
- This stream is passed through Alumina which is a catalyst for the Klaus reaction
- Then the stream is cooled to 150 degrees where Sulphur separates as a liquid.
- The stream is then heated again and passes through alumina for further conversion and liquid sulphur is extracted by cooling down this stream
- The process is done in a total of 3 beds to get very high conversion of H2S to S
- All the sulphur from the H2S and the CS2 section is collected and sent back with the feed.

Few notes

- Adding both the CS2 and the Sulphur recovery reaction in the flowsheet in simulation is tough and hence the simulation is done in 2 segments
- Conversion reactors are used due to absence of kinetic data. Much more accurate results can be obtained using a PFR or CSTR
- Since the flowsheet was broken into 2 separate parts, the recycling of sulphur wasn't possible. Hence, extra streams are added into the feed which mimic the composition of the actual recovered Sulphur streams.

CS_2 Plant Process Flow Diagram



Mancozeb Plant

- This plant was commissioned in 2007 having a max capacity of 23 kmol/hr and is currently running at 21 kmol/hr.
- Mancozeb is a fungicide which is manufactured by UPL under different grades and exporters to more than 70 countries on consumer demand.
- The final product is manufactured in a powder form and is packed in two categories i.e. 500 kg PVC bags and 25 kg paper bags.
- There exists another form of mancozeb which is known as WDG
- The production capacity of MNZ is 150 TPD and WDG plant is 42 TPD with monthly targets of 4200T of MNZ and 850T of WDG

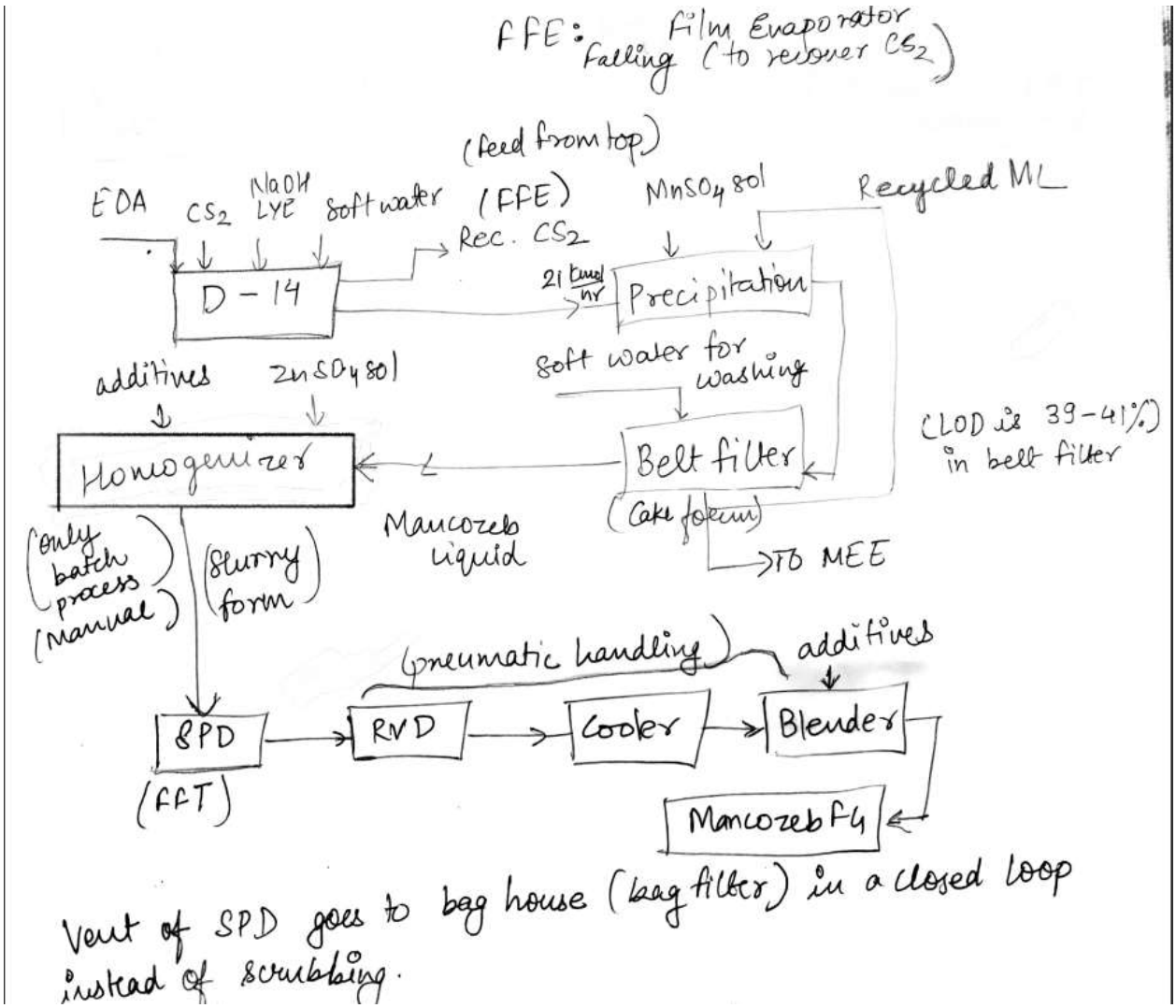
Mancozeb manufacturing process contains the following reactions:-

1) Ethylene Diamine + CS_2 NaOH + H_2O → D14
2) D14 + $MnSO_4$ ML → MANEB + ML
3) MANEB + $ZnSO_4$ + SLS + HMT DADAMOL → MNZ Slurry → SPD powder

MoC : Stainless Steel (SS)

- SLS (Sodium Lingo Sulphate) is used for suspension
- HMT is used as an antifire agent
- DADAMOL is used as an antifoaming agent
- MNZ obtained contains 1% $ZnSO_4$ and 2-2.5% $MnSO_4$

Mancozeb block diagram



Safety Measures

UPL has adopted the Japanese method of 5S of Safety:-

- Seiri (Sort) - Sort out unnecessary items in the workplace and discard them.
- Seiton (Set in Order) - Arrange necessary items in good order so that they can be easily picked for use.
- Seiso (Shine) - Clean your workplace thoroughly so that there is no dust on floors, machines, and types of equipment.
- Seiketsu (Standardise) - maintain high standards of the workplace at all times
- Shitsuke (Sustain) - train people to follow good housekeeping automatically.

The three major safety benchmarking parameters are-TRFR < 0.25 (total incidents/ total), SI = 0, MPSI = 0

Conclusion

Now we come to the conclusion of this detailed summary of our visit to UPL Ltd. as part of the Course on Wheels. We hope that we managed to cover every aspect of our visit thoroughly and documented it properly.

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We would like to thank Professor Sanjay Mahajani, for being an excellent guide and mentor throughout the duration of the course.

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Finally, we would like to thank UPL Ltd. for giving us the opportunity to explore and educate ourselves about the working of a pharmaceutical formulation facility.

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