



Oxygen Enrichment at Sulphur Recovery Unit

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- TÜPRAŞ Overview
- Project Summaries

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KOÇ GROUP
Overview

- Koç Group is Turkey's largest industrial and services group in terms of revenues, exports, employees, taxes paid and market capitalization at Borsa İstanbul.
- Koç Holding has leading positions with strong competitive advantages in various sectors, such as energy, automotive, consumer durables and finance.
- Following an average annual growth rate of 11% in consolidated profit in US\$ terms between 2005-2015, Koç Holding ranks among the world's top 500 companies.

Largest Industrial Group in Turkey

4 of the top 5 industrial enterprises in Turkey are Koç Group companies*

- #1 Tüpraş
- #2 Ford Otosan
- #3 Arçelik
- #5 Tofaş

Largest Exporters in Turkey

4 of the top 10 exporters in the Turkish Exporters' Assembly ranking are Koç Group companies**

- #1 Ford Otosan
- #2 Tüpraş
- #6 Tofaş
- #7 Arçelik

Largest R&D Investments in Turkey

Turkey's Largest Intellectual Property Rights Portfolio with more than:

- 7,500 trademarks
- 4,100 patent families
- 9,600 patents
- 800 industrial design registrations
- 5,400 Internet domain names

3 Koç Group companies ranked in the top 10 on the Turkish Patent Institute's list of "the Highest # of Patent Applications" in 2015

- #1 Arçelik
- #3 Ford Otosan
- #4 Tofaş

Leadership Positions in Strategic & Lucrative Business Lines

Energy



Main Companies

Tüpraş* / Opet / Aygaz* / Entek

Domestic Market Position – Market Share

Sole petroleum refiner in Turkey
#1 in LPG distribution – 29%
#2 in petroleum products distribution – 18%

Automotive



Main companies

Ford Otosan* / Tofaş* / TürkTraktör* / Otokar* / Otokoç

International Alliances

Ford Motor Co. / Fiat Chrysler
Automobiles / Case New Holland

Domestic Market Position – Market Share

#1 in total automotive – 22%
#3 in passenger cars – 13%
#1 in commercial vehicles – 52%
#1 in farm tractors – 47%
#1 in automotive retailing
#1 in car rental
#2 in operational car leasing

Consumer Durables



Main Companies

Arçelik*

International Alliances

LG
Electronics
(Air conditioner manufacturing)

Domestic Market Position – Market Share

#1 in white goods – c. 50%
#1 in air conditioners – 51%

Finance



Main Companies

Yapı Kredi Bankası*

International Alliances

UniCredit

Domestic Market Position – Market Share

#4 in total banking assets among private banks
#1 in credit cards – 22% (outstanding volume)
#1 in leasing – 20%
#1 in factoring – 18%
#2 in mutual funds -17%

Other Lines of Business

Main Companies

Tat Gıda* (Food) / Koçtaş (DIY Retailing) / Setur (Duty Free) / Marmaris Altinyunus* (Tourism)

* Listed companies

Koç Energy Group

Refining



Fuel Distribution



LPG & Natural Gas



Electricity

Entek

Mining



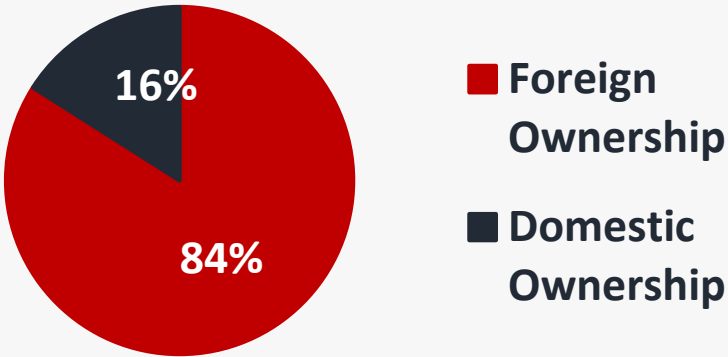
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TÜPRAŞ
Company Overview

Tüpraş Shareholder Structure

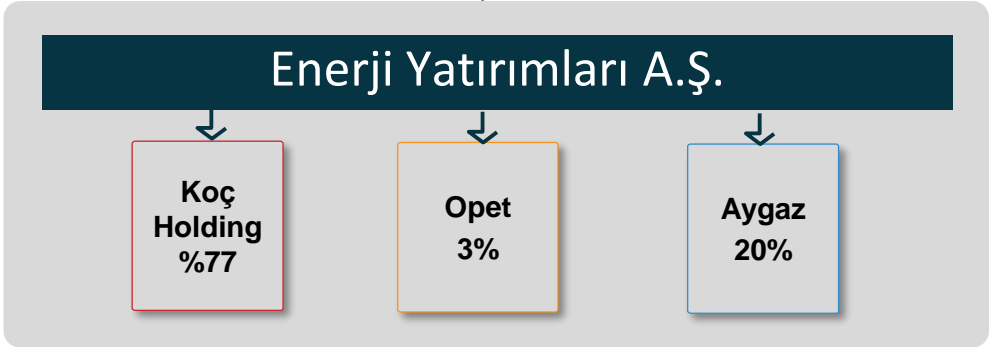
Publicly Traded
49 %

Distribution of Domestic / Foreign
Ownership of Tüpraş shares

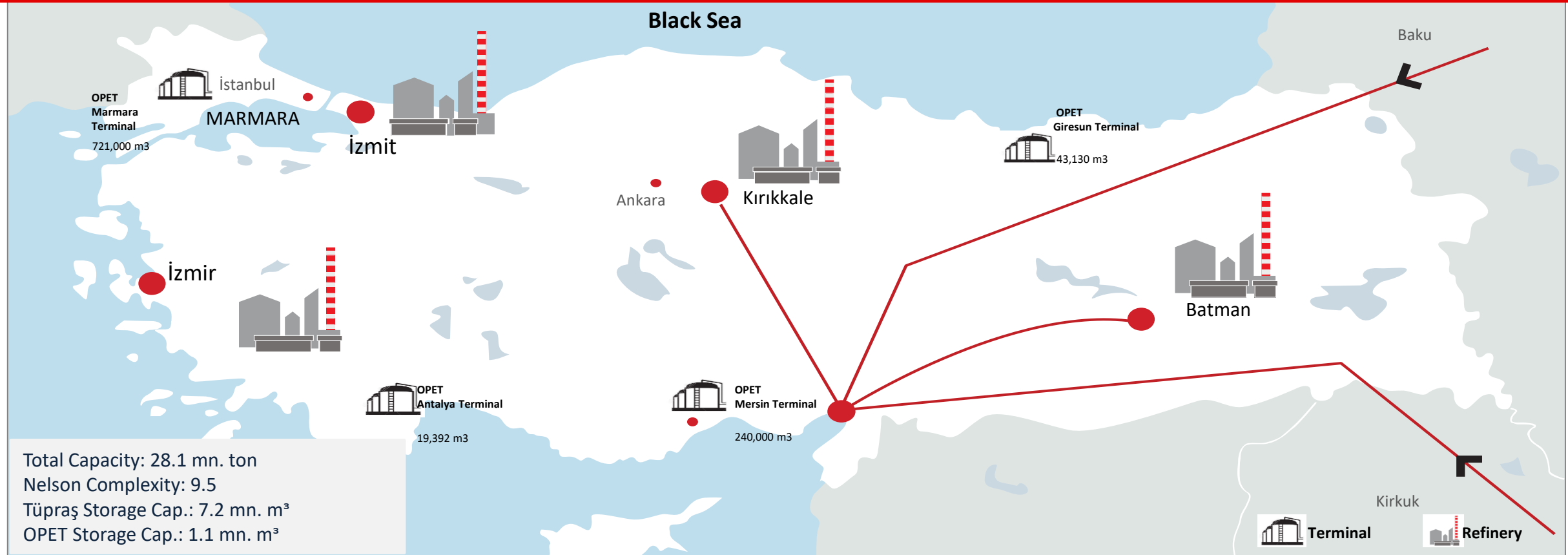


DİTAŞ	%79,98
	%40
Körfez Hava Ulaştırma	%100

51%



Tüpraş Refining Assets & Distribution Network



İzmit

- 11.0 MT Capacity
- NC: 14.5
- Storage Capacity: 3.0 mn m³

İzmir

- 11.0 MT Capacity
- NC: 7.66
- Storage Capacity: 2.5 mn m³
- Base oil 400 k tons

Kırıkkale

- 5.0 MT Capacity
- NC: 6.32
- Storage Capacity: 1.4 mn m³

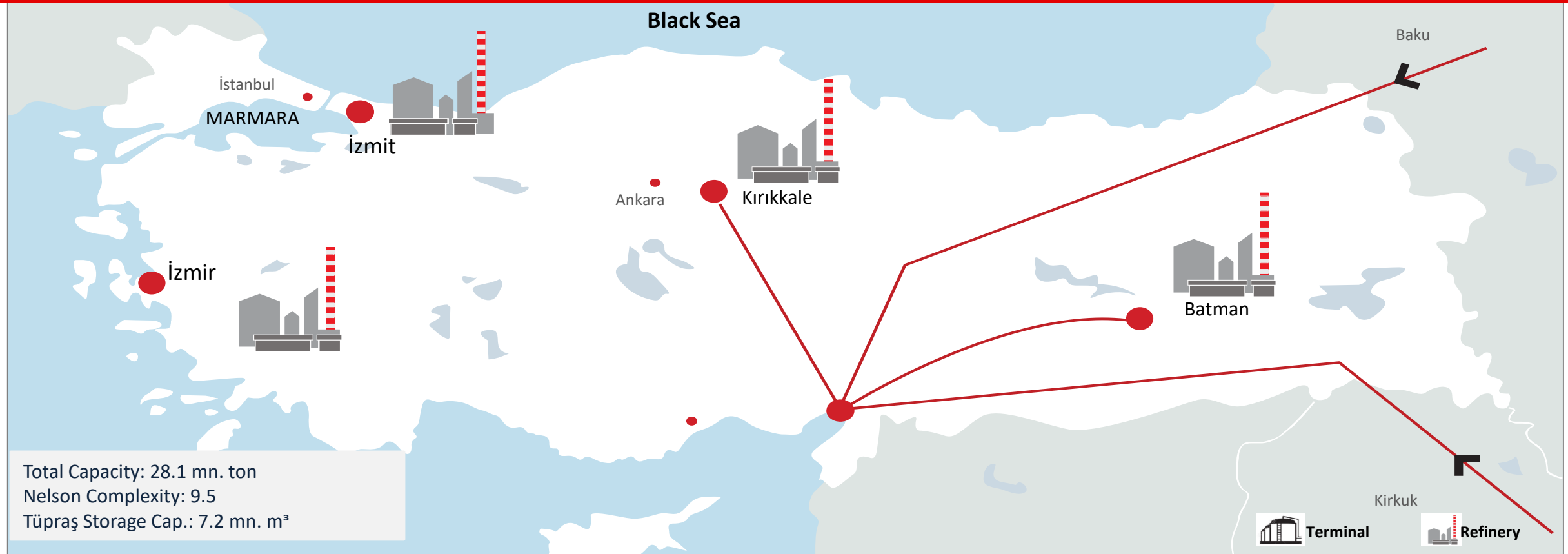
Batman

- 1.1 MT Capacity
- NC: 1.83
- Storage Capacity: 0.25 mn m³

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Project Summaries

Tüpraş Sulphur Recovery Units



İzmit

- 3 SRU Units
- 70 ton/day Claus
- 190 ton/day SuperClaus
- 420 ton/day EuroClaus

İzmir

- 2 SRU Units
- 65 ton/day Claus
- 182 ton/day SuperClaus

Kırıkkale

- 2 SRU Units
- 60 ton/day Claus
- 75 ton/day SuperClaus

Tüpraş Sulphur Recovery Units

	Izmit Refinery			Izmir Refinery		Kirikkale Refinery	
Technology	Claus+SCOT	SuperClaus®	EuroClaus®	Claus	SuperClaus®	Claus	SuperClaus
Licensor	Black&Veatch	Jacobs Comprimo	Jacobs Comprimo	Amoco	Jacobs Comprimo	B&V	Jacobs Comprimo
S/U year	1997	2007	2015	1993	2005	1993	2009
Design Capacity (tpd)	90	170	420	65	179	60	75
Maximum Operating Capacity (tpd)	90	190	460	65	197	60	80
Service Unit	HYC	CCR, HYC	HYC, Coker	HYC	CCR	HYC	CCR



- Definition of Project

Installation of low level Oxygen Enrichment Unit in SRU units.

- Scope of Project

The main objective of SRU is install oxygen enrichment unit to increase sulphur product capacity in SuperClaus ® and EuroClaus ® process with minimum investment and operational cost, maximum operation flexibility and reliability in Izmit, Izmir and Kirikkale Refineries.

- Project Schedule

Process Study : 6 months

Implementation & start-up 6 months for each unit.

- Project Cost

2-5 MUSD. Investment cost includes commissioning, procurements, civil works, assembly, roads, automation, E&I works.

The Aim of Oxygen Enrichment in SRU units.

- Debottlenecking of existing SRU (capacity increase)
- Reduction of process gas volume
- Reduction of pressure drop
- Reduction of energy consumption
- Increase of combustion temperature
- No damaging or change of burner, combustion chamber and boiler

The Effect of Oxygen Enrichment in SRU units on,

- Sulfur Conversion

- COS CO, COS, CS₂ Emissions

- Energy consumption

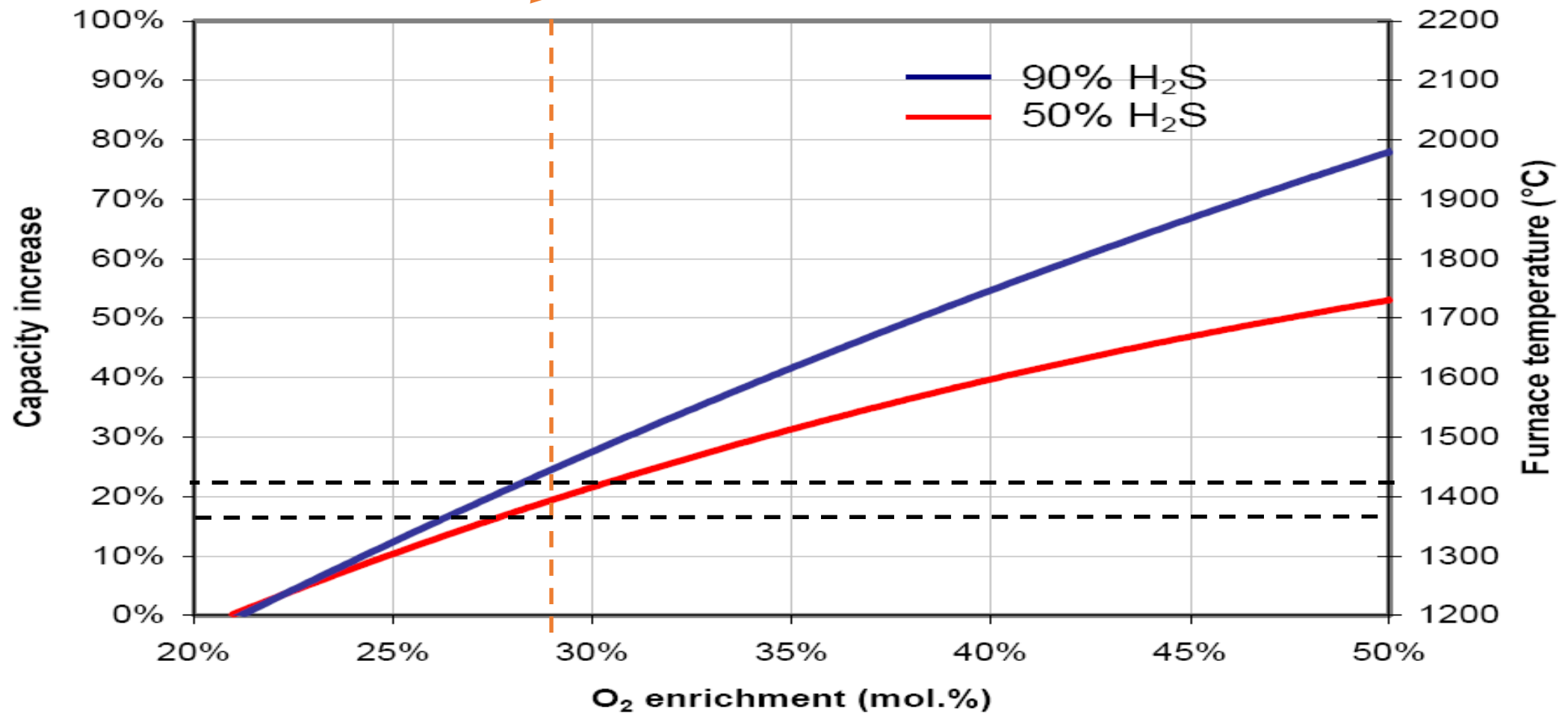
- Emission

- RF temperature

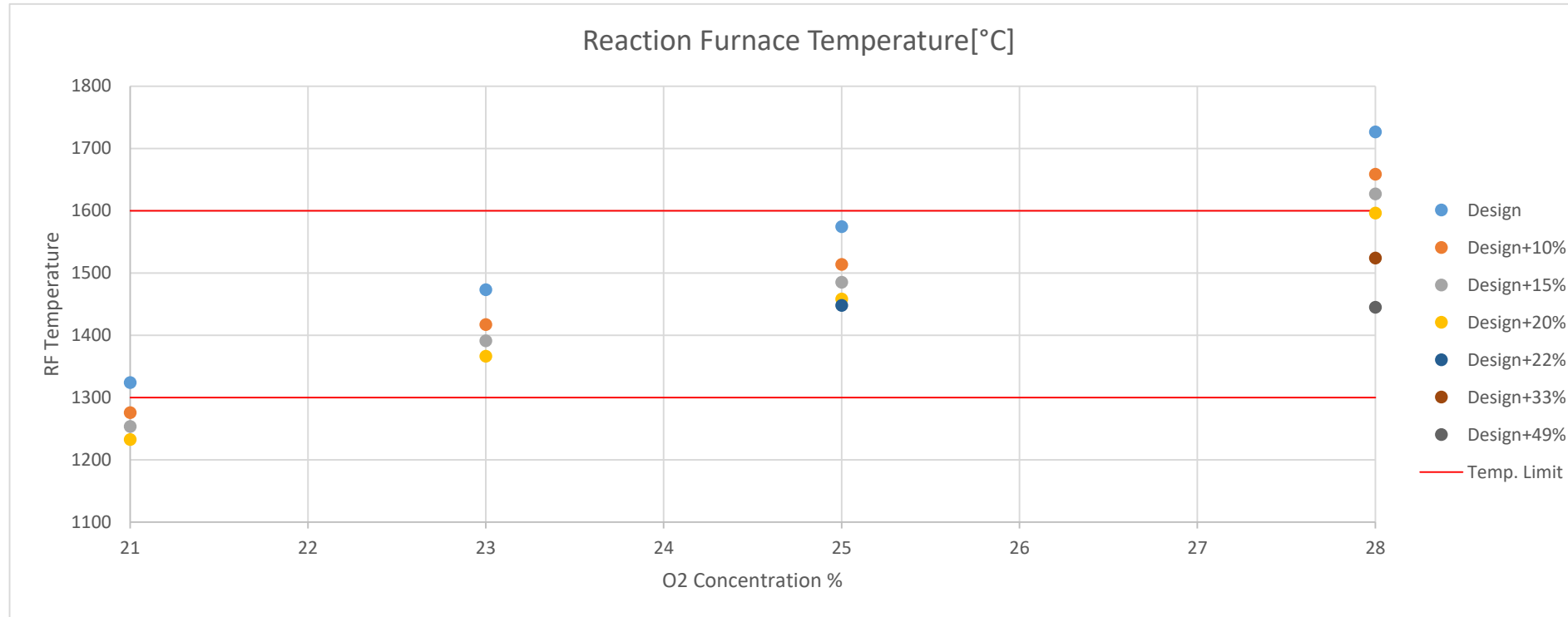
- Mechanical Integrity.

Enrichment Limits for SRU's

Safety limit for O₂-Enrichment: 28%



Design Evaluation of Enrichment in SRU's



Design Evaluation of Enrichment in SRU's

O2 Concentration %	ARU [m3/h]	SWS [m3/h]	RF Temperature [°C]	Energy Obtained from WHB [kJ/h]	CO, COS, CS2 Emissions to C- 101 [kmol/h]	Sulfur Recovery Efficiency %	Sulfur Produced [tpd]	Emissions to Incinerator [ppmmol]	Design +
21	6070	2284	1323.8	5.79E+07	0.95	98.67	209.5	25.3	0
	6677	2512	1275.7	5.85E+07	0.99	90.06	208.4	Failure: Superclaus (insufficient air)	10%
	6981	2627	1253.5	5.88E+07	1.01	85.97	210.0	Failure: Superclaus (insufficient air)	15%
	7288	2740	1232.5	5.89E+07	1.02	82.26	209.4	Failure: Superclaus (insufficient air)	20%
23	6070	2284	1473.1	6.47E+07	1.20	90.11	191.3	9.8	0
	6677	2512	1417.1	6.57E+07	1.25	96.01	224.3	15.9	10%
	6981	2627	1391.1	6.61E+07	1.27	98.41	240.3	25.1	15%
	7288	2740	1366.2	6.65E+07	1.29	99.54	253.7	96.9	20%
	7405	2786	1356.8	6.66E+07	1.30			Failure: Superclaus (insufficient air)	22%
25	6070	2284	1574.4	6.91E+07	1.36	83.84	178.0	7.8	0
	6677	2512	1513.5	7.02E+07	1.41	90.42	211.2	10.4	10%
	6981	2627	1485.1	7.07E+07	1.44	93.27	227.8	12.6	15%
	7288	2740	1457.9	7.12E+07	1.47	95.85	244.3	16.4	20%
	7405	2786	1447.6	7.13E+07	1.47	96.79	250.7	18.7	22%
	8073	3038	1393.4	7.22E+07	1.52			Failure: Superclaus (insufficient air)	33%
28	6070	2284	1726.3	7.55E+07	1.56	74.37	157.9	6.4	0
	6677	2512	1658.4	7.67E+07	1.64	81.77	191.0	7.8	10%
	6981	2627	1626.7	7.73E+07	1.67	85.01	0.0	8.7	15%
	7288	2740	1596.2	7.78E+07	1.71	87.99	224.3	9.9	20%
	8074	3038	1523.6	7.92E+07	1.78	94.62	267.2	15.3	33%
	9044	3403	1444.6	8.06E+07	1.86	99.75	315.6	156.1	49%
	9105	3426	1440.0	8.06E+07	1.87			Failure: Superclaus (insufficient air)	50%

Management Standarts X Operational Discipline



Operational Excellence

- Management Standarts

Process Hazard Analysis, HAZOP,

MOC-Tech & Process Technology package of project

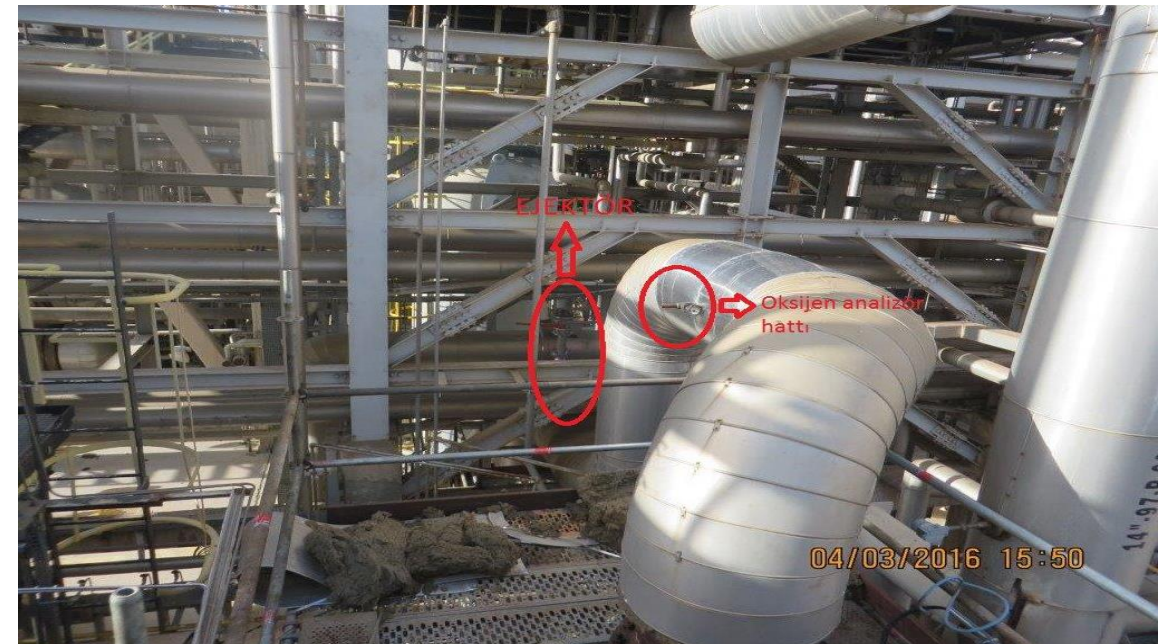
Procedures, work permits

with

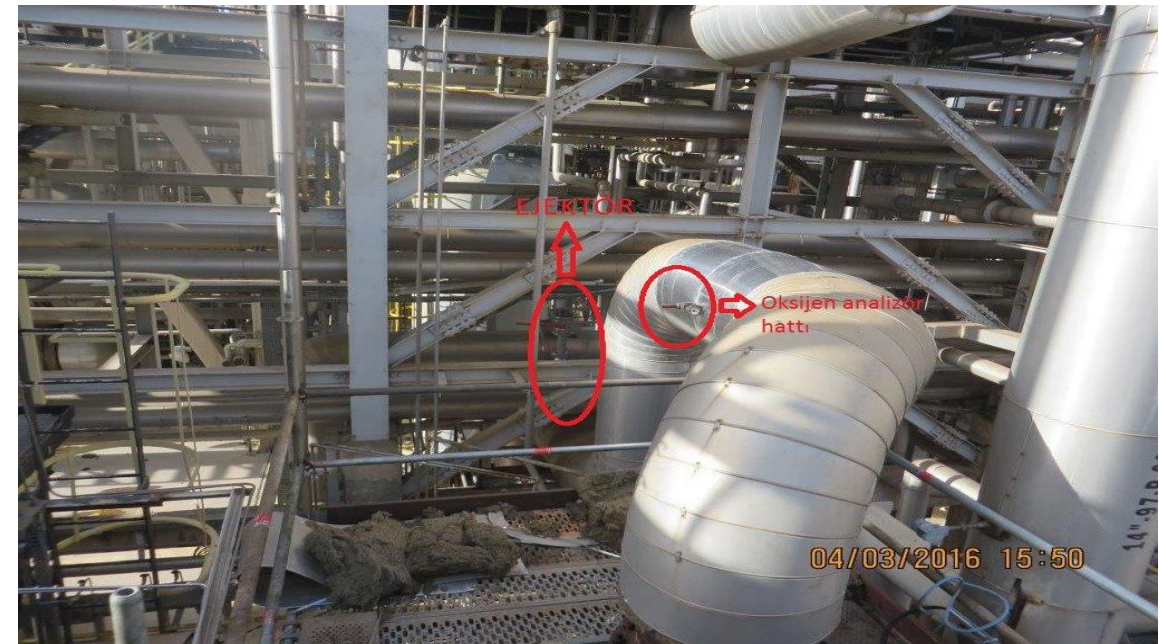
trained FLM's(first line managers) and Leaders

dedicated team work

Site Execution Enrichment Location in SRU's



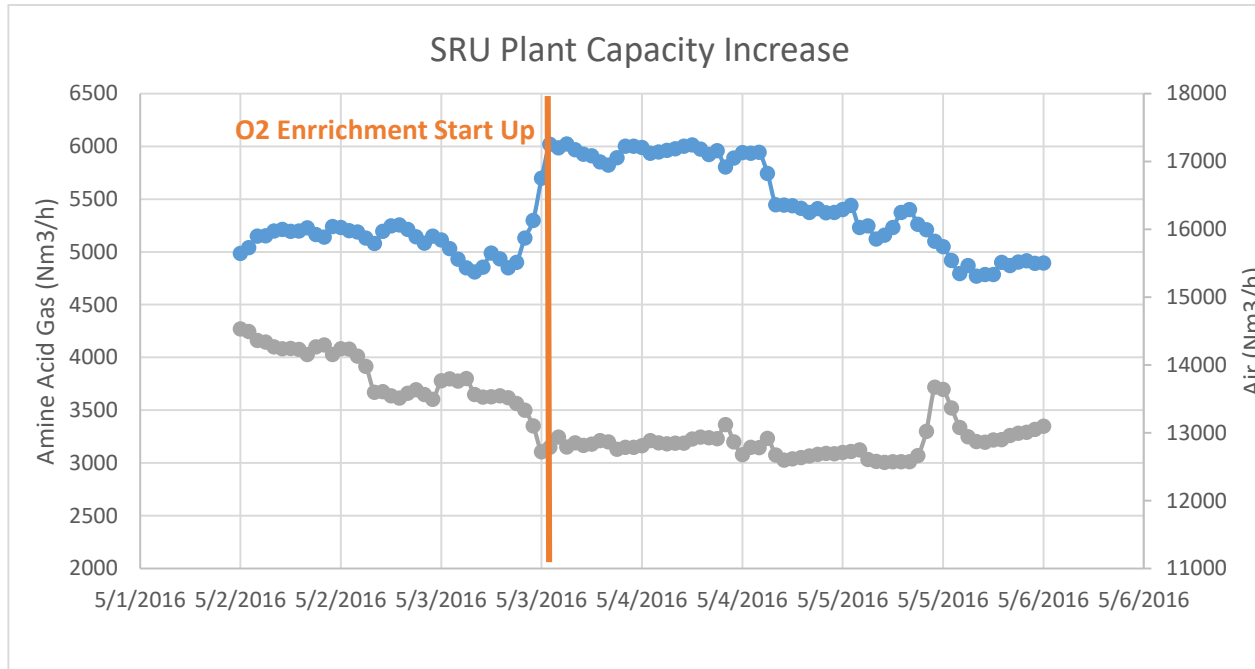
Enrichment Location in SRU's



Equipment Overview



Performance Evaluation of Enrichment in SRU's



- Capacity Increase % 15
- No need additional equipment
- PSRM and HAZOP requirements overviewed.
- Quickwin project
- Min investment and quick return on Investment
-

SRU O2 Enrichment Economic Results

- Project Economic Results
- 15-20 % SRU capacity increase
- Project time 6-9 months
- Project Cost 2-5 mUSD
- Project Income :20-25 mUSD (incl Crude oil margin)

Thanks



 **Tüpraş**

 **Koç**