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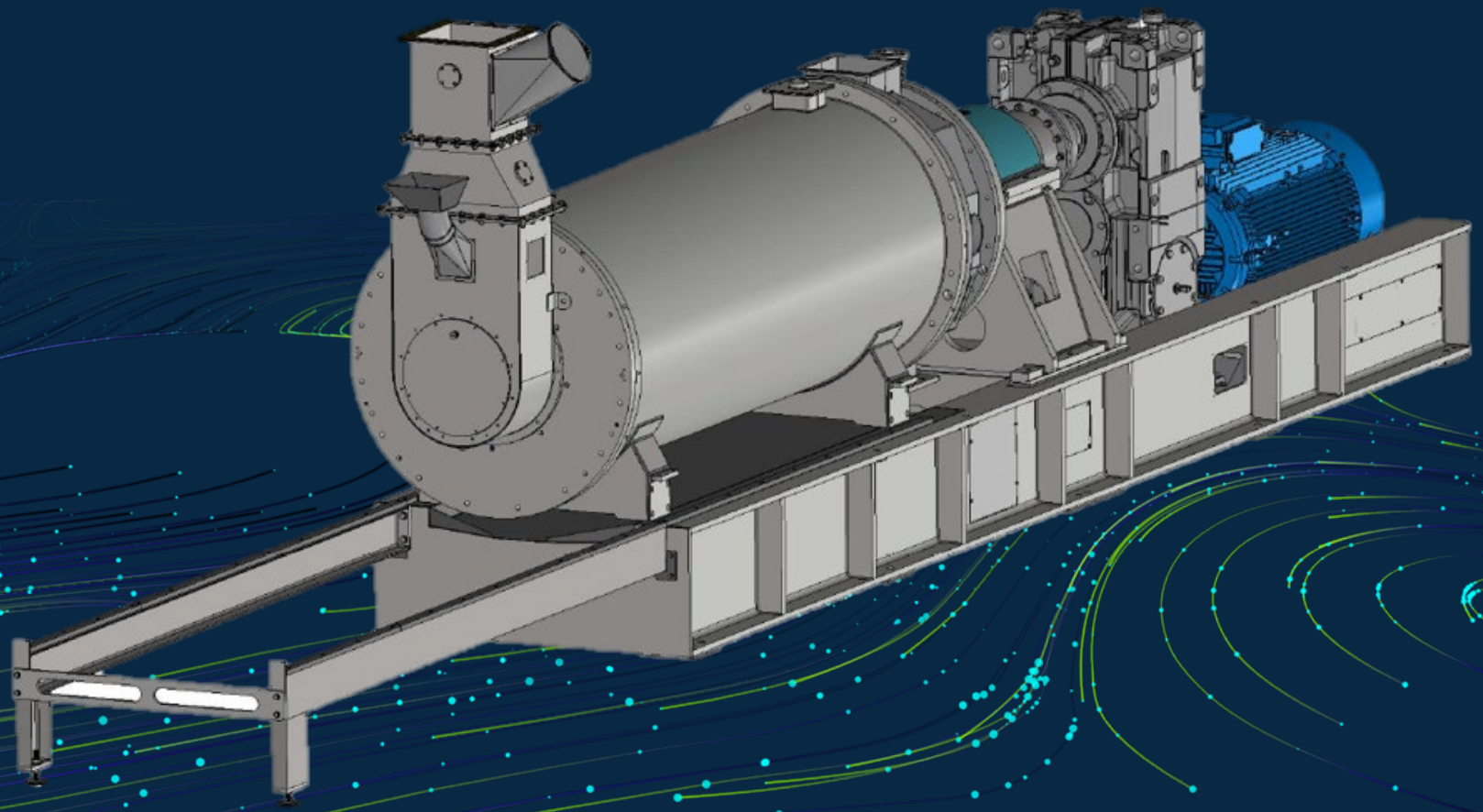
CEMENT GRINDING
APPLICATIONS OF

HORIZONTAL MILLS

Prof. A. Hakan Benzer



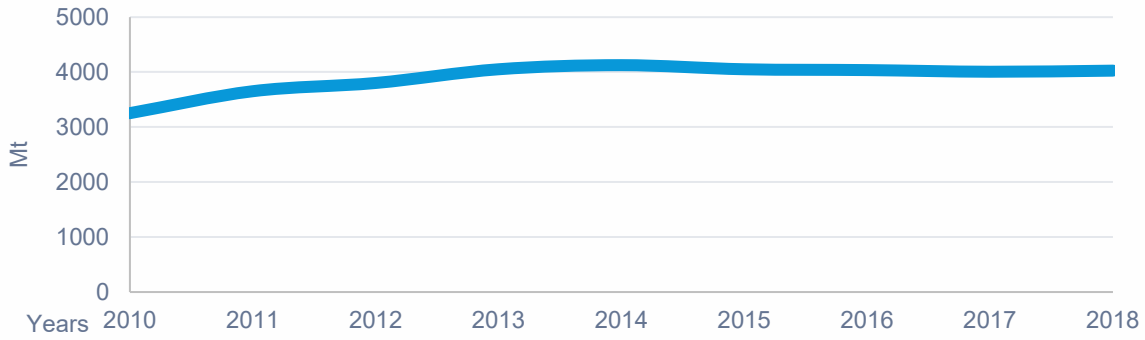
0312 473 32 38 -39

www.minervamuhendislik.com.tr

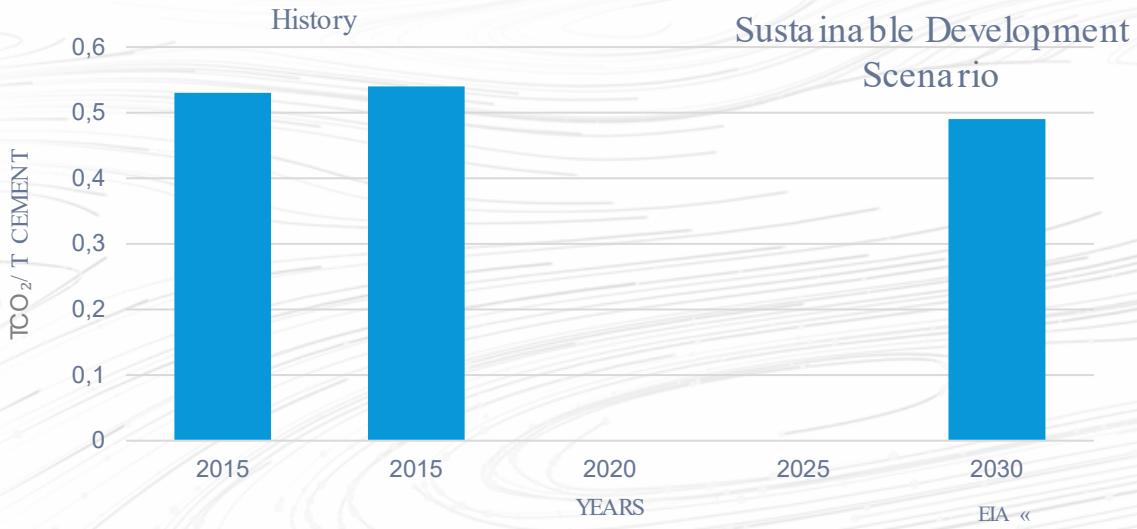
info@minervamuhendislik.com.tr

CONTENT

World Cement Production



Direct CO_2 Intensity of Cement



The direct CO2 intensity of cement production **increased 0.3% per year .**

Focus point:

- Reducing the clinker-to-cement ratio
- Deploying innovative technologies
- Increasing uptake of alternative fuels

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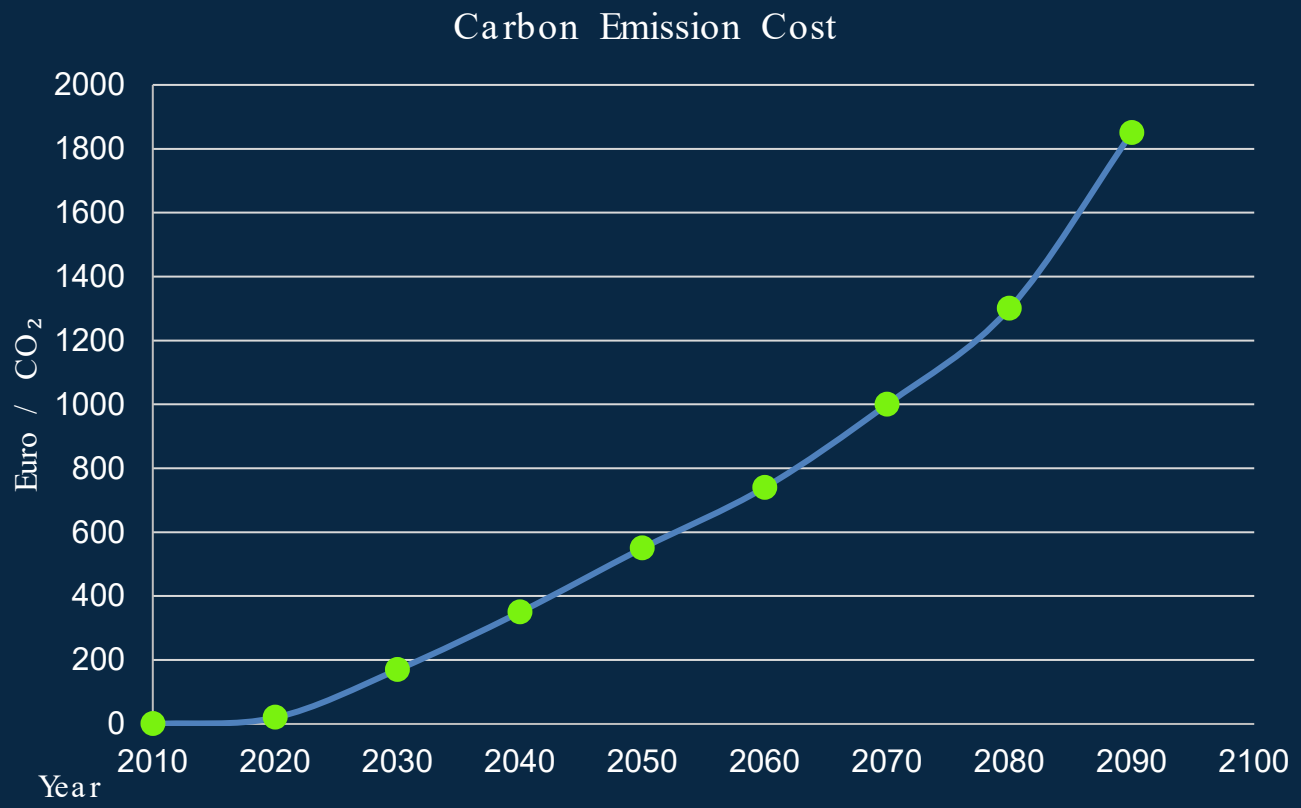
CARBON EMISSIONS TARGET OF 2030

30% REDUCTION



Total cement production (tonnes)

70 Million Tonnes

Average Energy Consumption

kWh /t 90

CO_2

0,478 kg/ kWh

1 Tone CO_2

400 euro

CO_2 Incremental Cost

1.2 Billion euro

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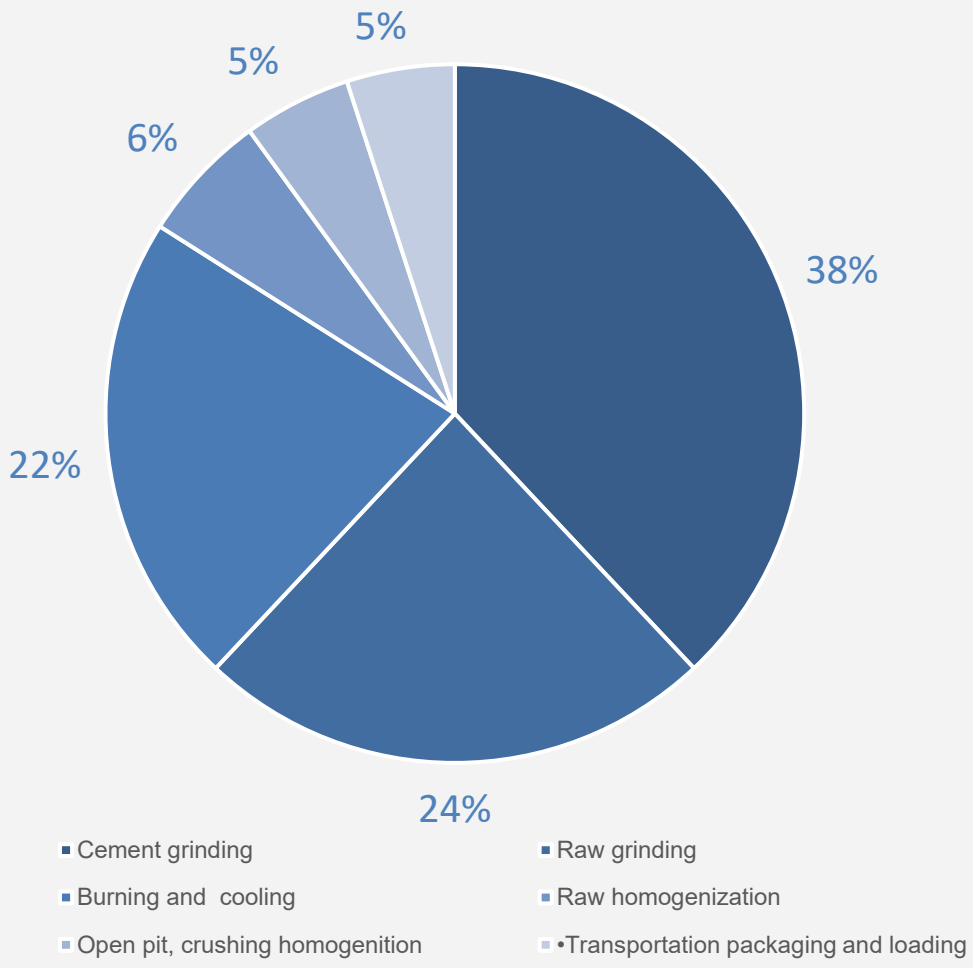
SOME KEY FACTS ABOUT CEMENT INDUSTRY



Per kWh

0.478 kg

CO_2

Tax of 1 ton CO_2 is 88 Euro today

Real value

250 Euro

CO_2 tax cost of a typical cement mill (approximative)

5 Euro / ton

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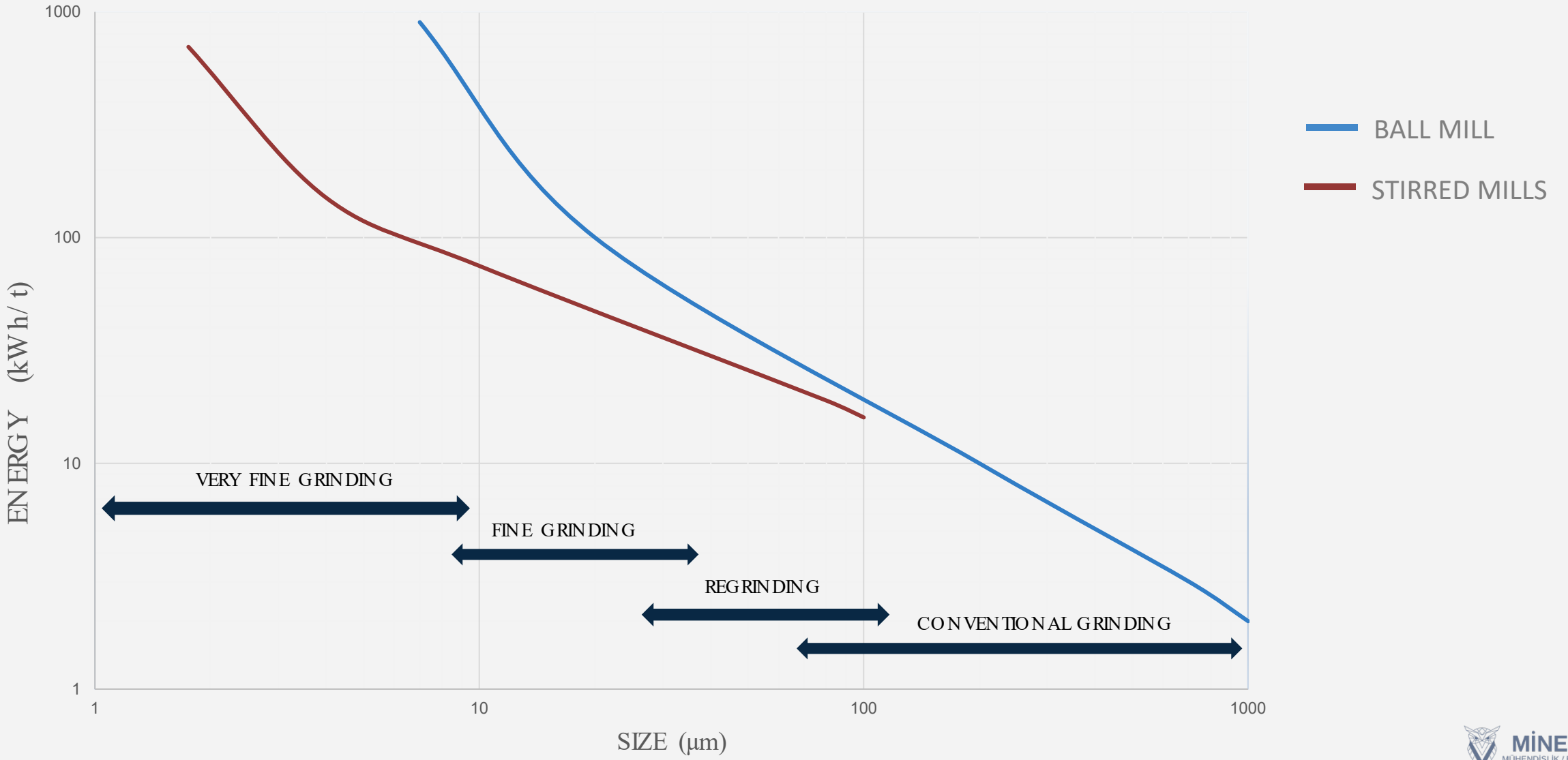
FINE AND VERY FINE GRINDING



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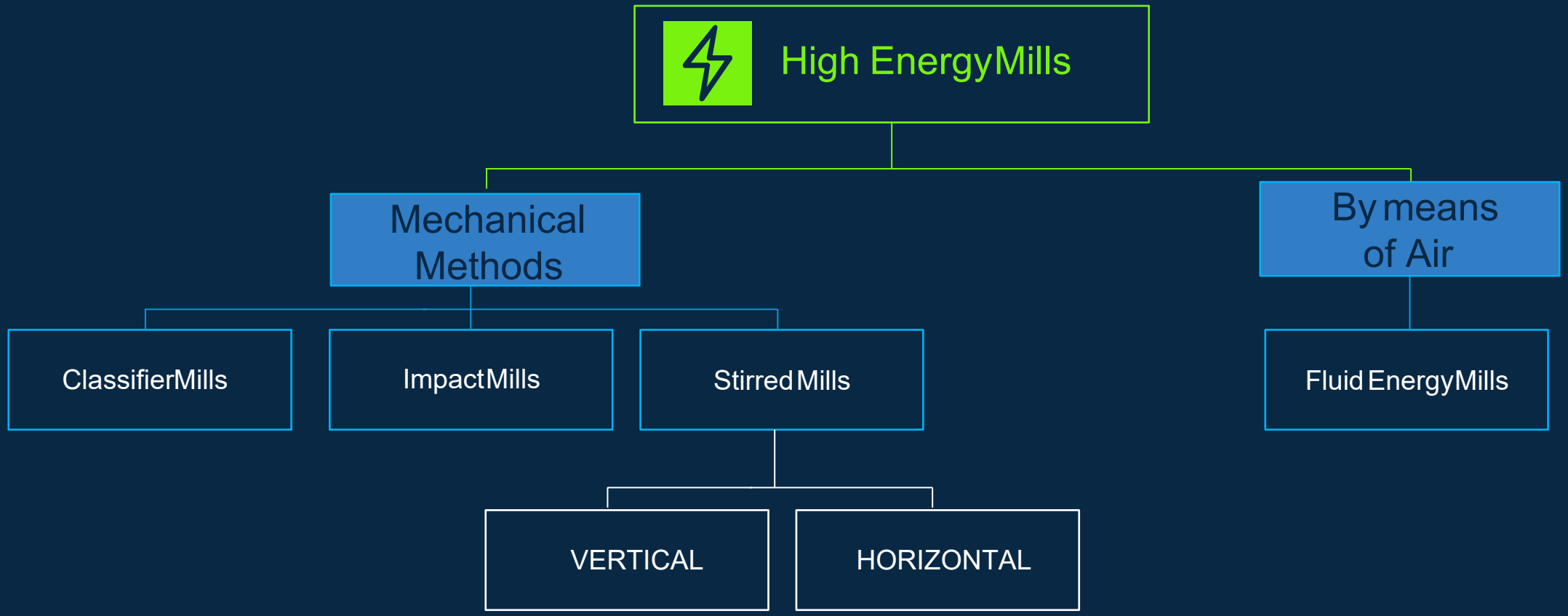
NEW TECHNOLOGY GRINDING SYSTEMS



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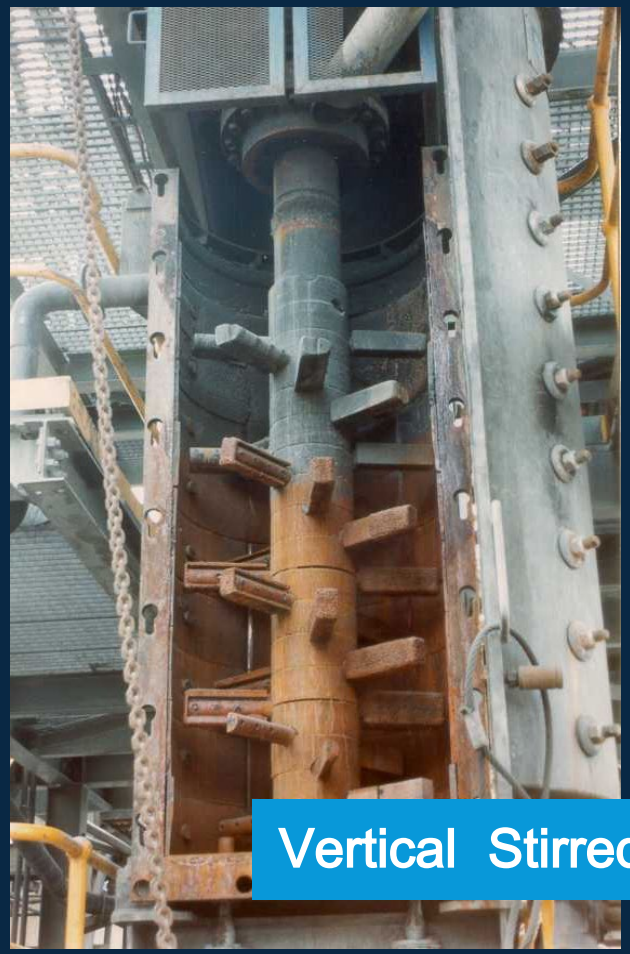
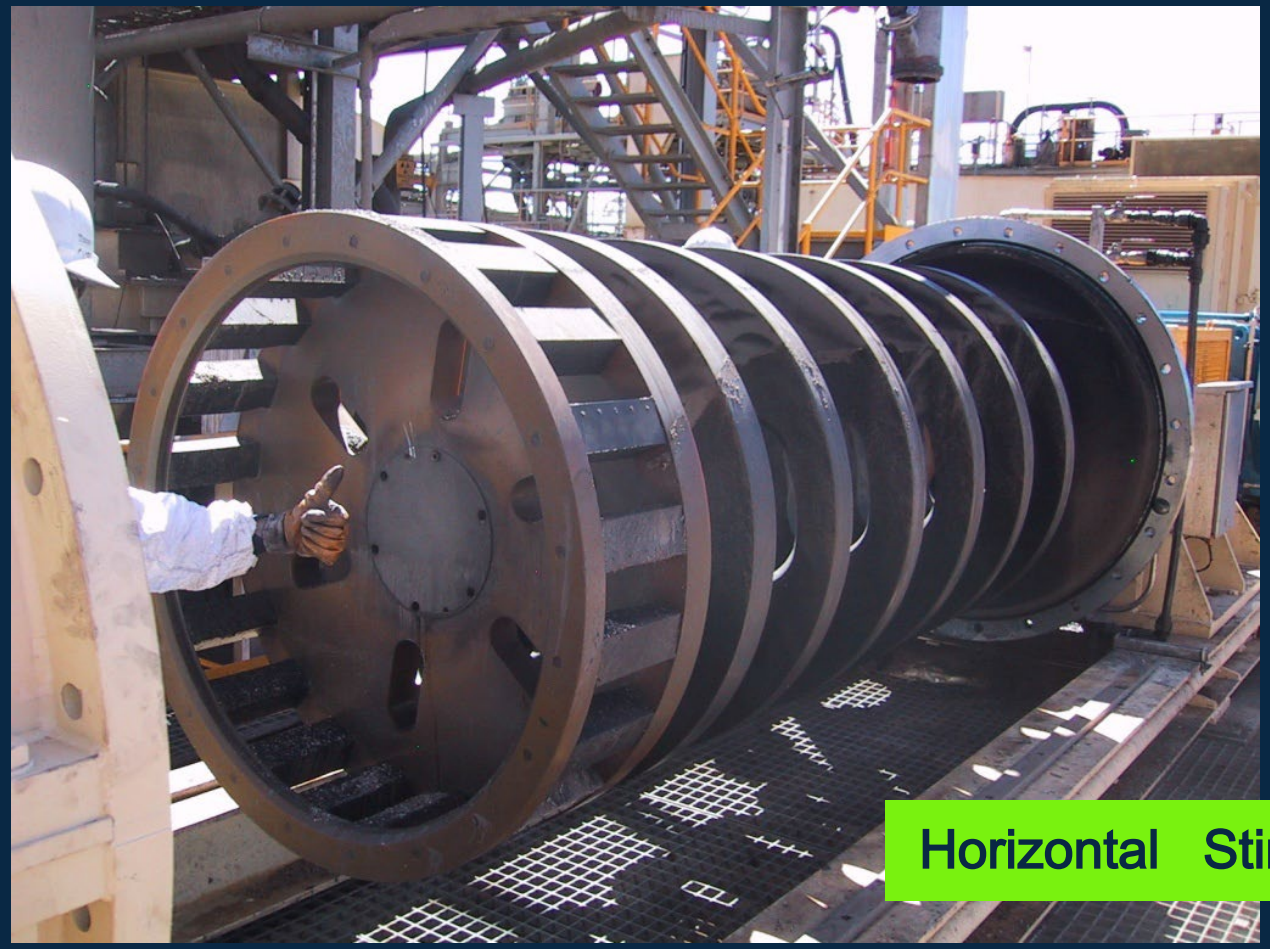
STIRRED MILLS



Vertical Stirred



Horizontal Stirred

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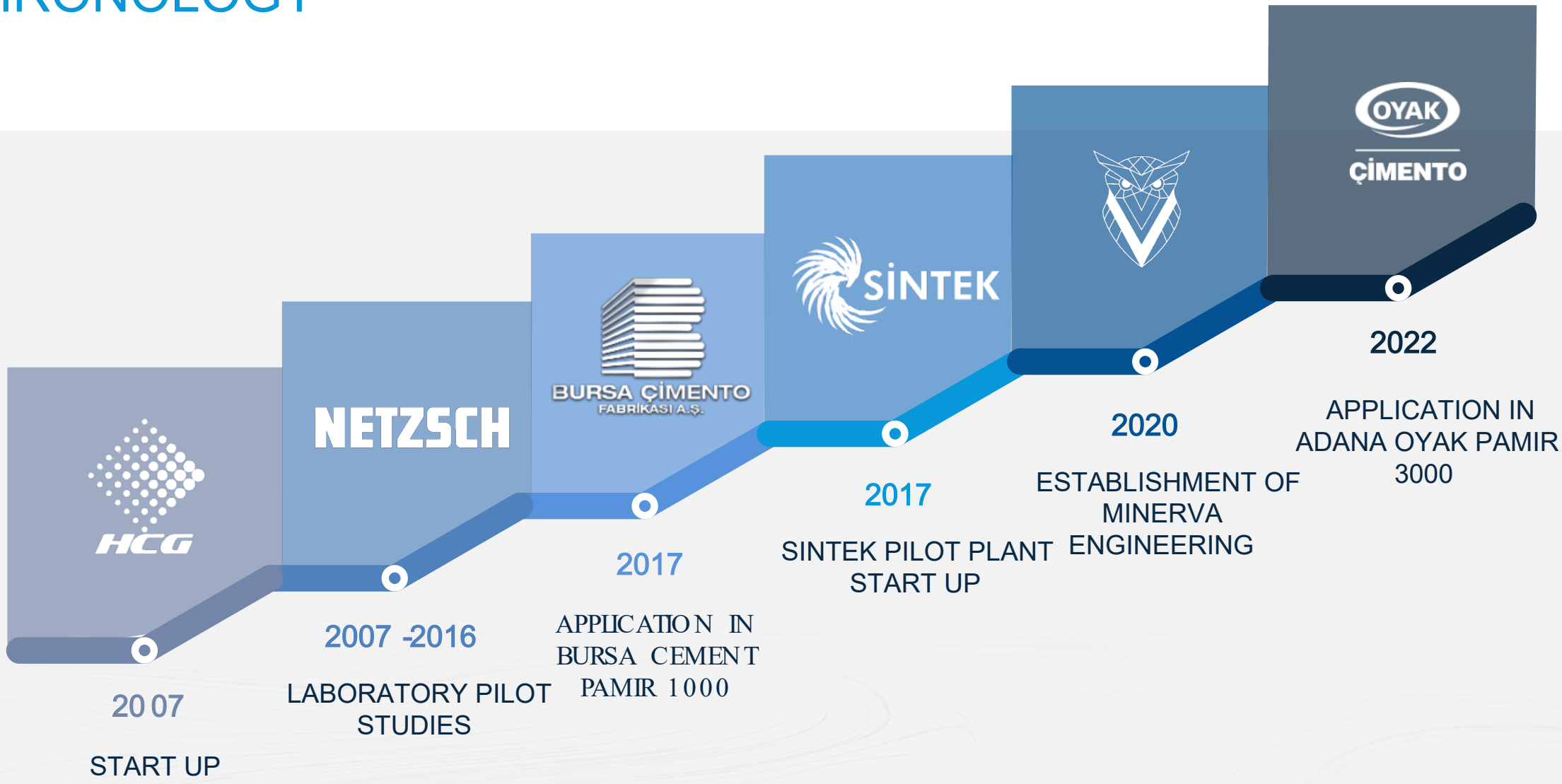
CHRONOLOGY



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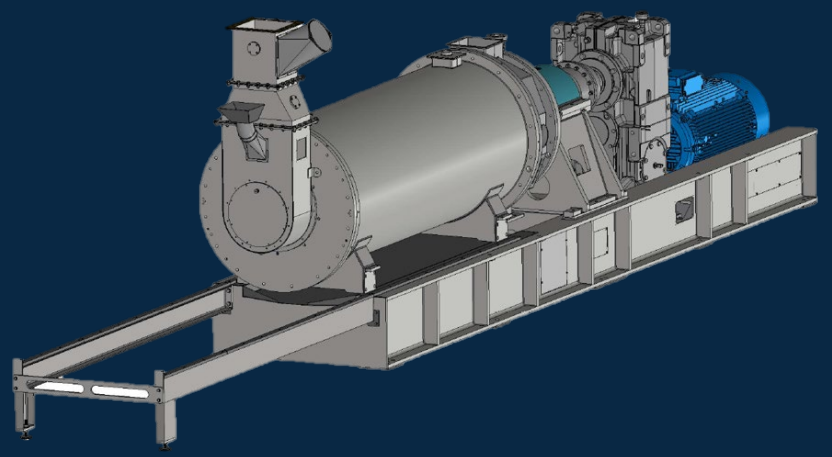
PAMIR TECHNOLOGY - COMPARISON

	Diameter (m)	Length (m)	Installed Power (kW)	Mill Volume m^3	Power Intensity (kW/m^3)
Ball Mill	4.2	13	2600	90	28,8
Vertical Stirred	2.5	2.5	520	12	42
Horizontal Stirred	1.3	3	1120	3	280

	Ball Size (mm)	Amount of Ball (piece)
Ball Mill	20	96.000
Pamir	1	1.145.000.000



	Ball Mill	Pamir
Ball Volume	< 32%	< 85%
Mill speed	2.5 - 3.5 m/s	5 - 8 m/s
Ball Size	> 20 mm	> 1 mm

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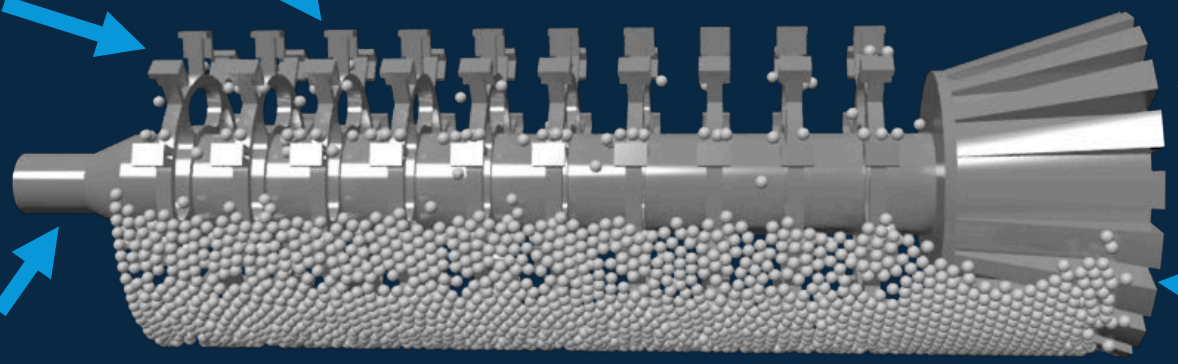
Shaft rotating at high speeds generating disc tip speeds ~ 20 m/s

Multiple stages of grinding

Grinding disks

Product



Grinding chamber

Shaft

Product separator

Recirculating grinding patterns of media occur between disks due to variation in velocity across disks

Media centrifuged to outside of grinding chamber by high centrifugal force generated inside mill

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VARYING VOLUME OF GRINDING CHAMBERS- PAMIR

Pamir 30

Pamir 1000

Pamir 3000

DESIGN

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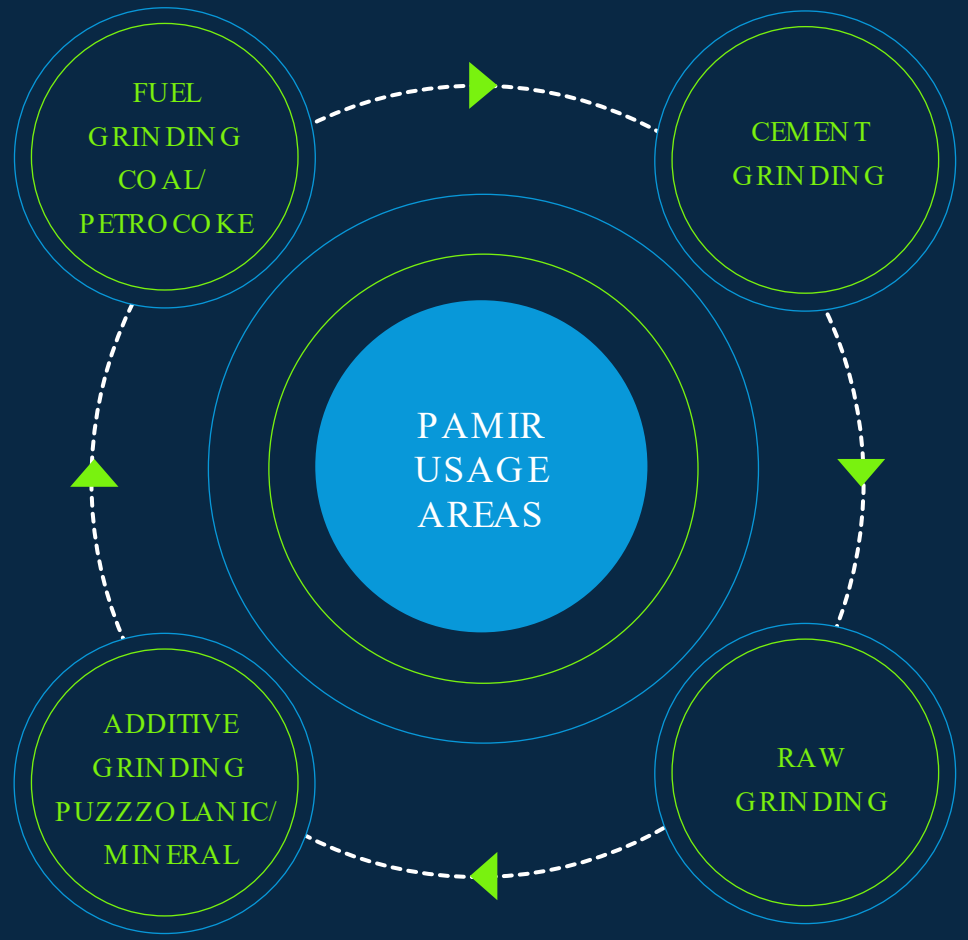
USAGE AREAS OF PAMIR

FEEDING LENGTH
<500 µm / Feed moisture < 1,5%

- Capacity increasing
- Energy consumption saving
- Preventing the grinding problem of hard-to-grind fuels
- Shortening the flame length by fine grinding



- Capacity increasing
- Energy consumption saving
- Quality improvement
- Clinker factor decreasing
- Ultra fine cement production

- Clinker factor decreasing
- Quality Improvement with Super Filling Material
- Increasing Pozzolanic Effect with Mechanical Activation

- Capacity increasing
- Energy consumption saving
- Elimination of cooking difficulties caused by silica

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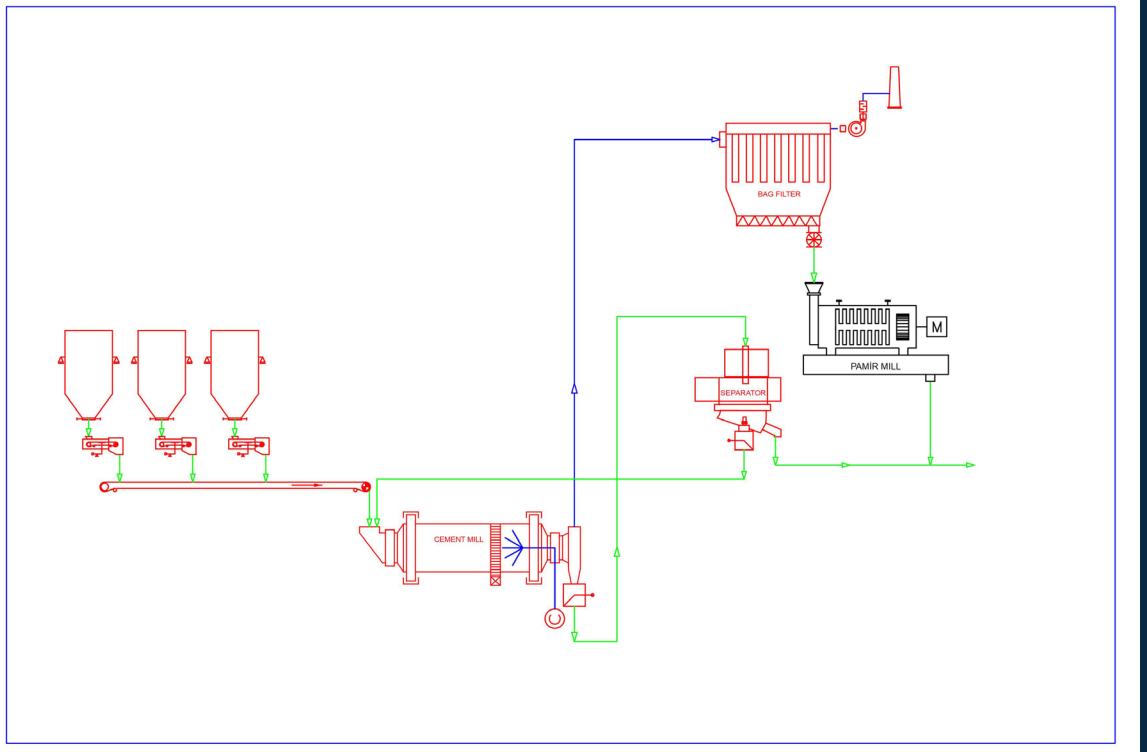
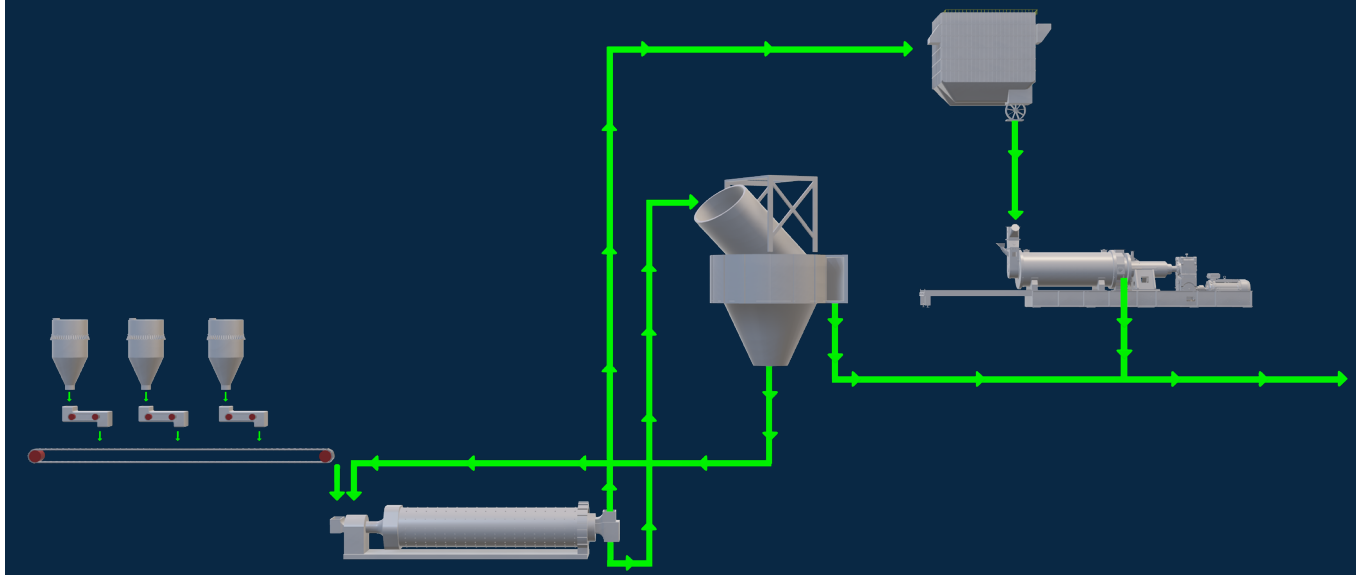
APPLICATION FIELDS
BALL MILL





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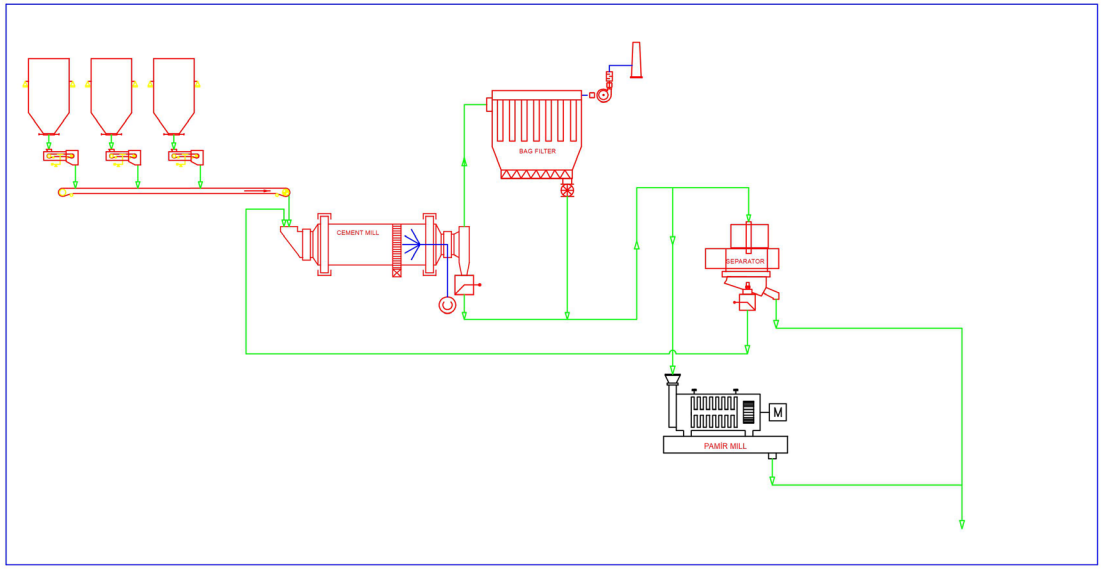
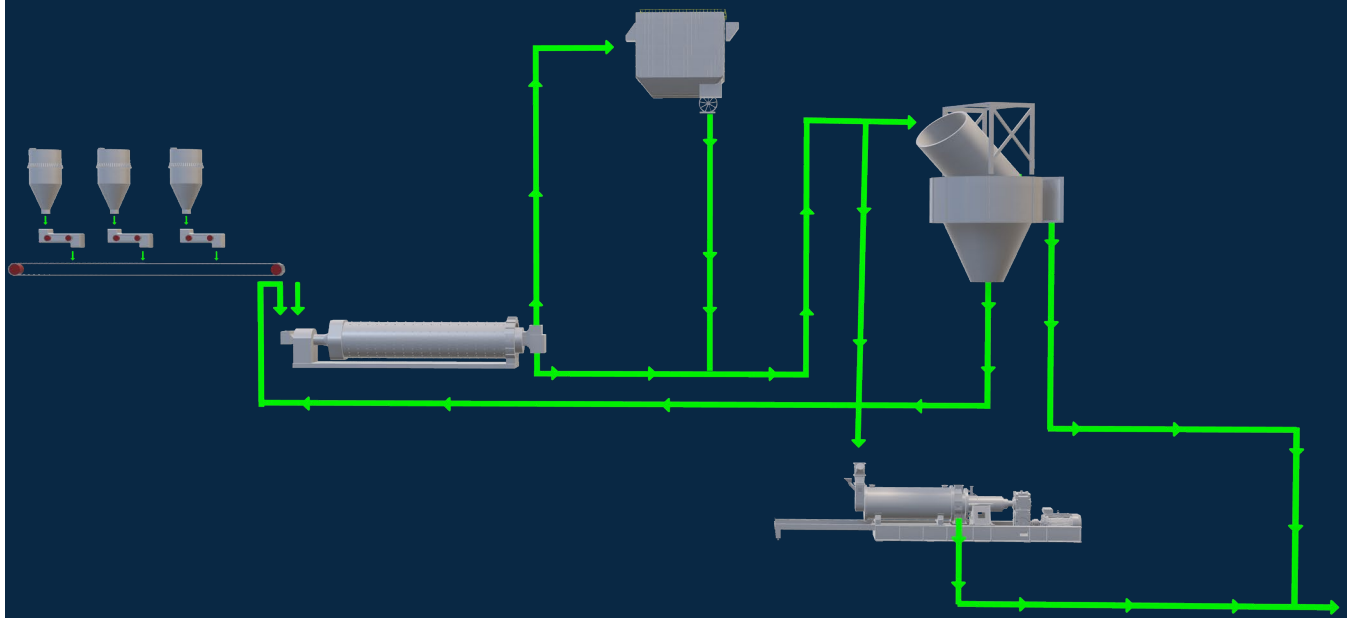
APPLICATION FIELDS
BALL MILL





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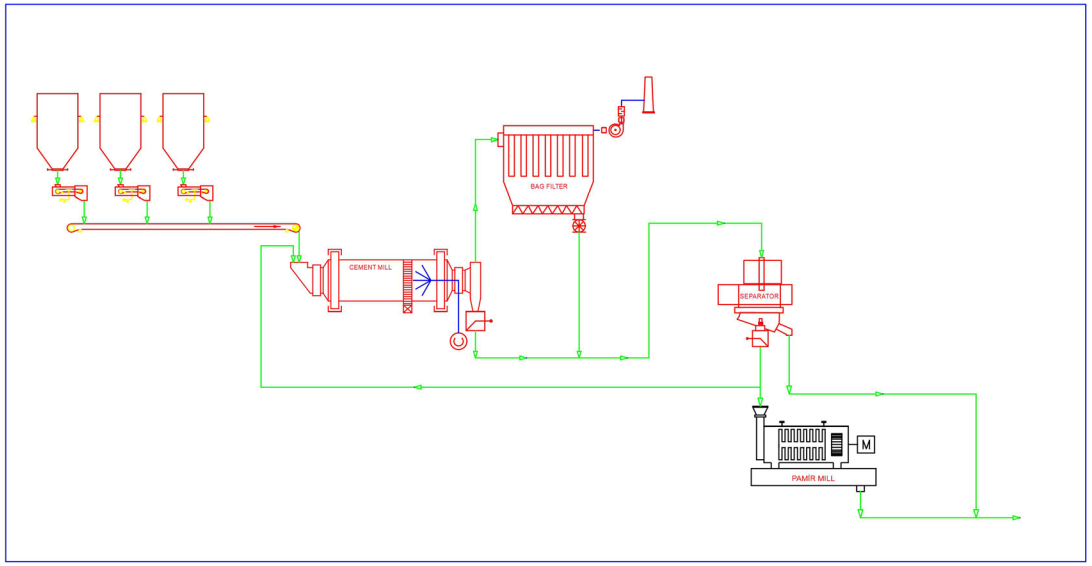
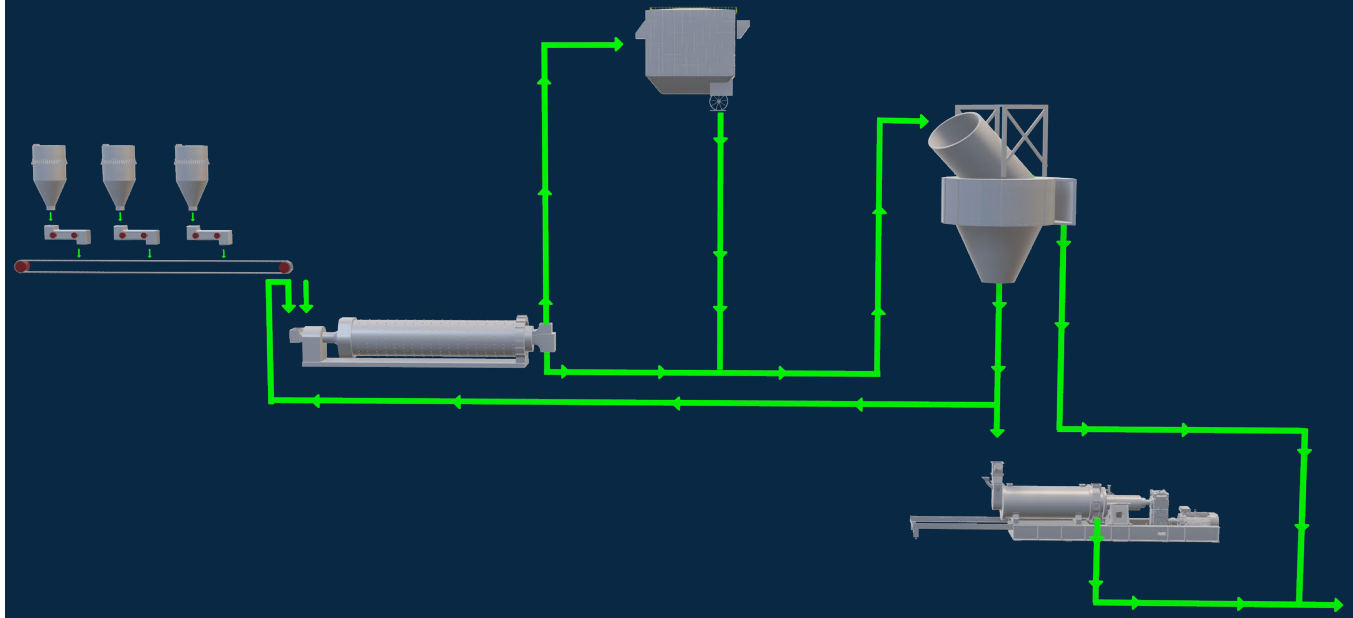
APPLICATION FIELDS
BALL MILL





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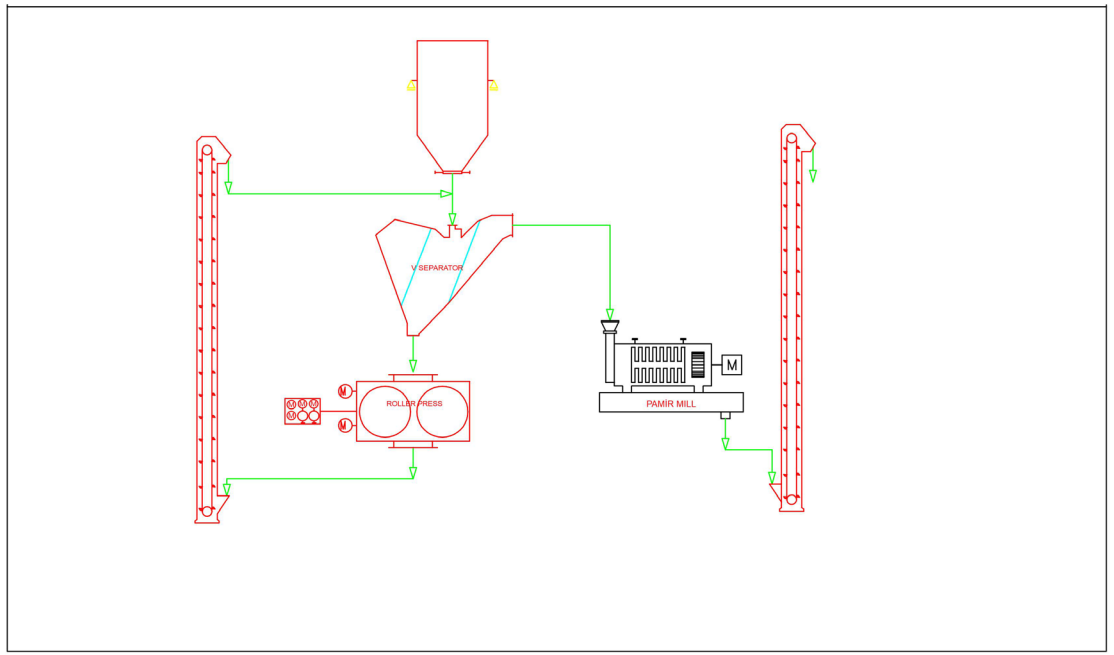
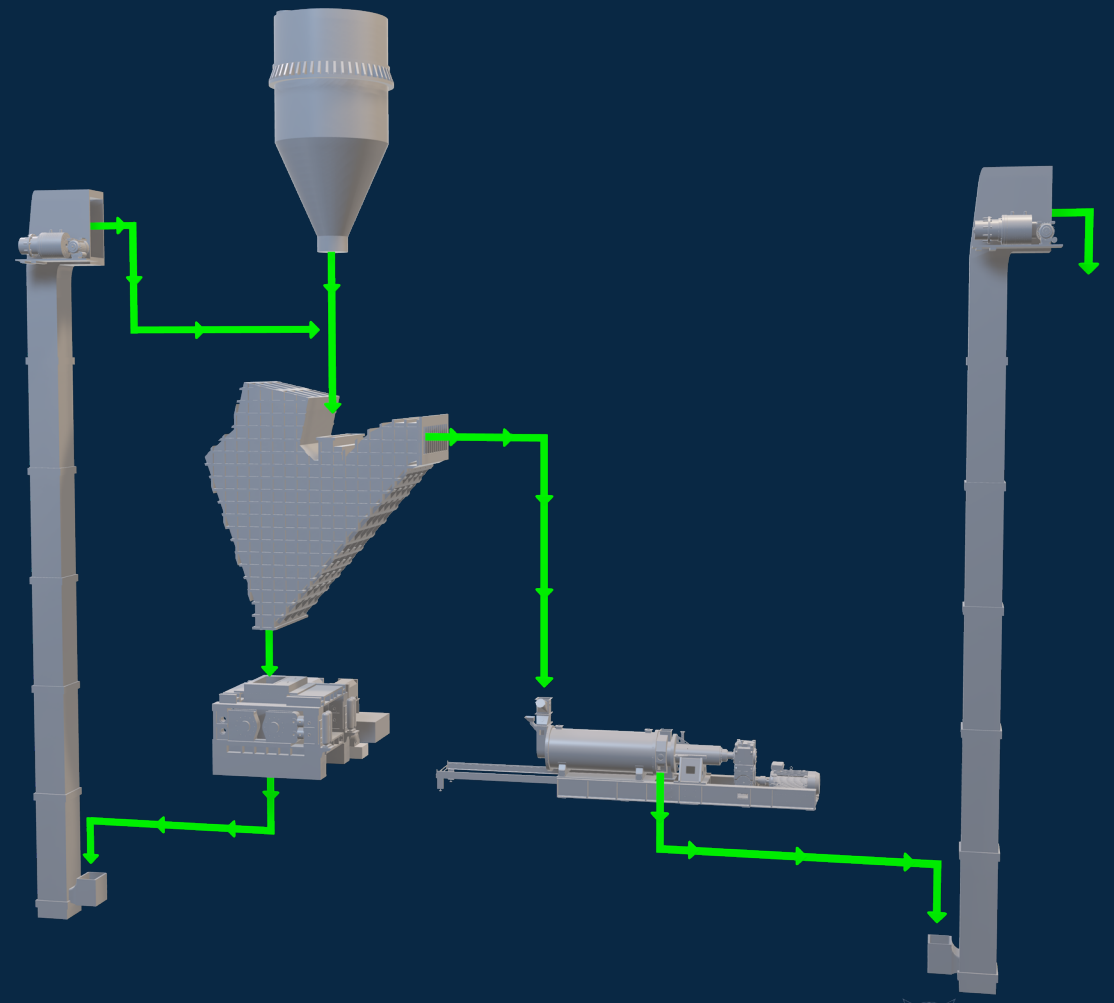
APPLICATION FIELDS
BED BREAKAGE SYSTEMS

Roller Pres Semi Final Grinding Circuit





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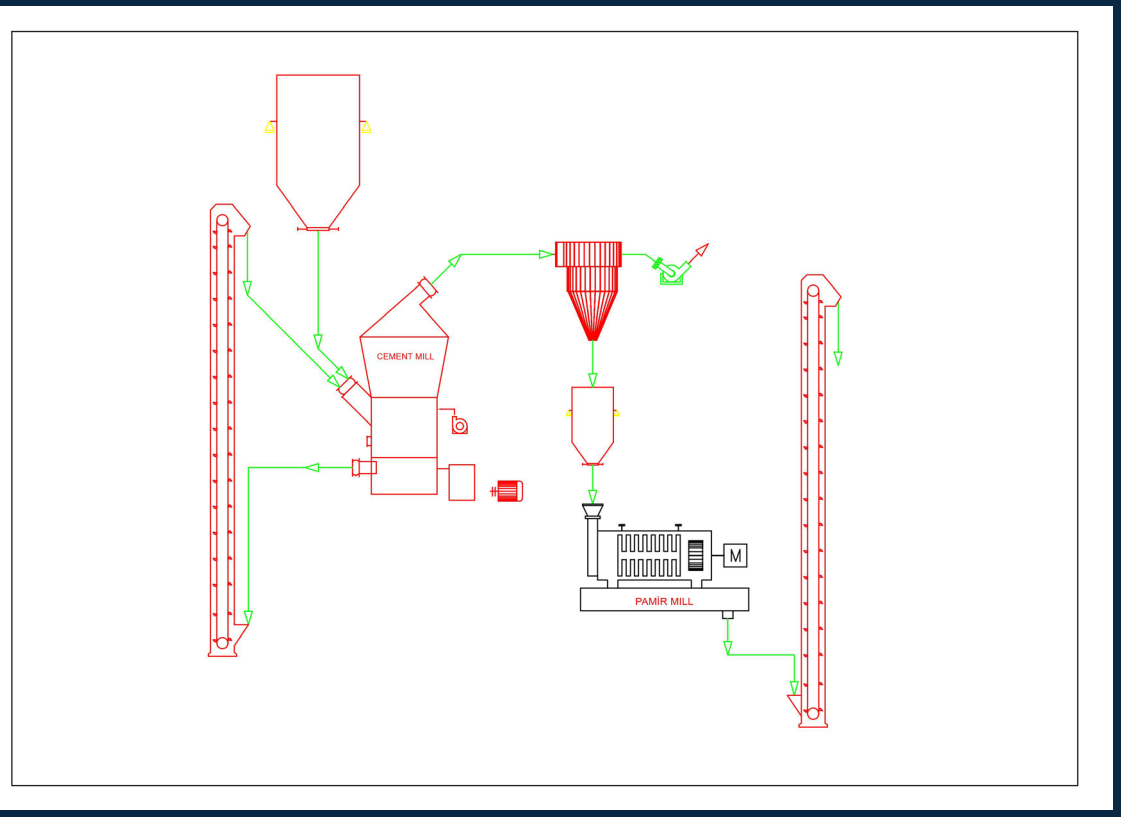
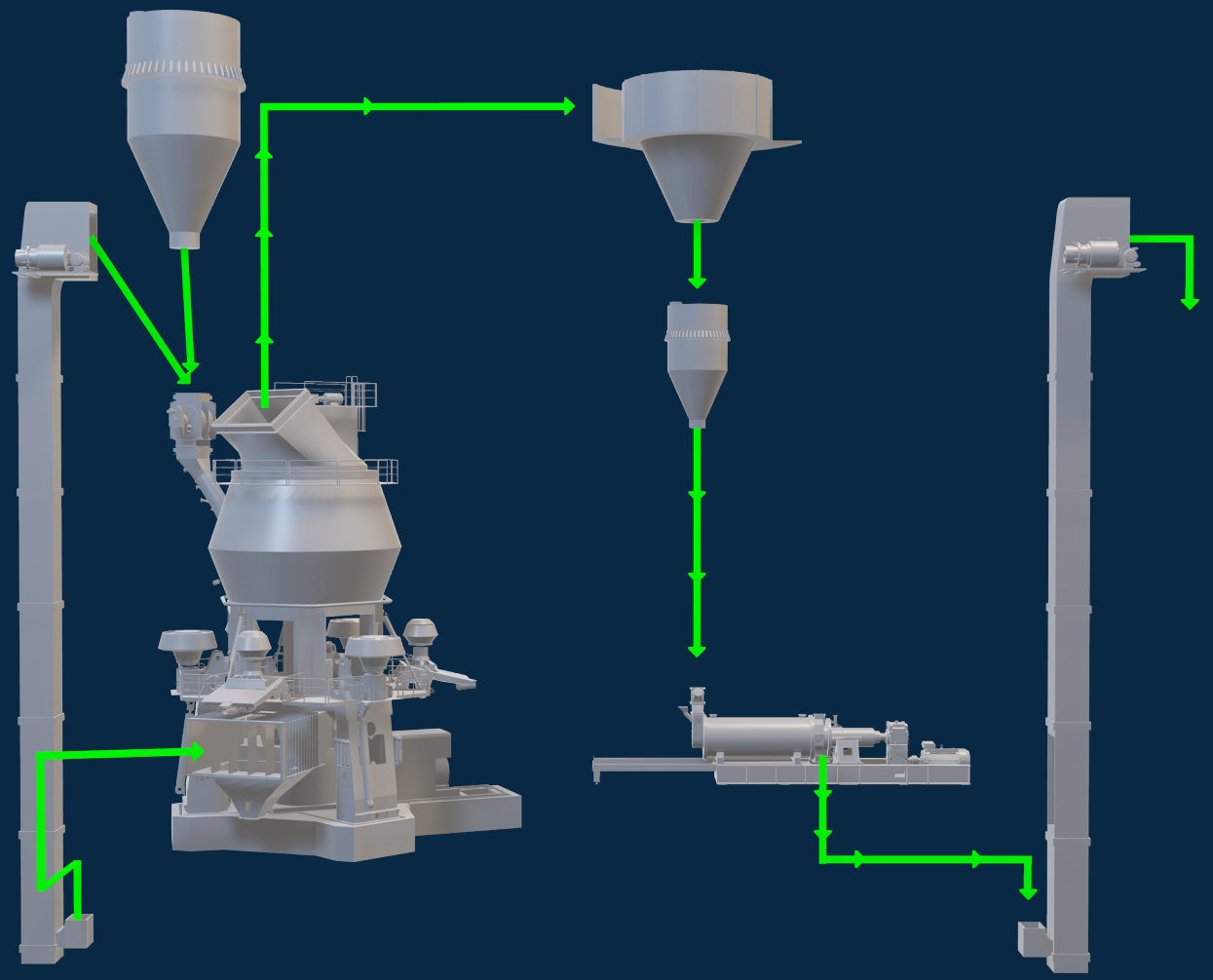
APPLICATION FIELDS
BED BREAKAGE SYSTEMS

Vertical Roller Mill Application





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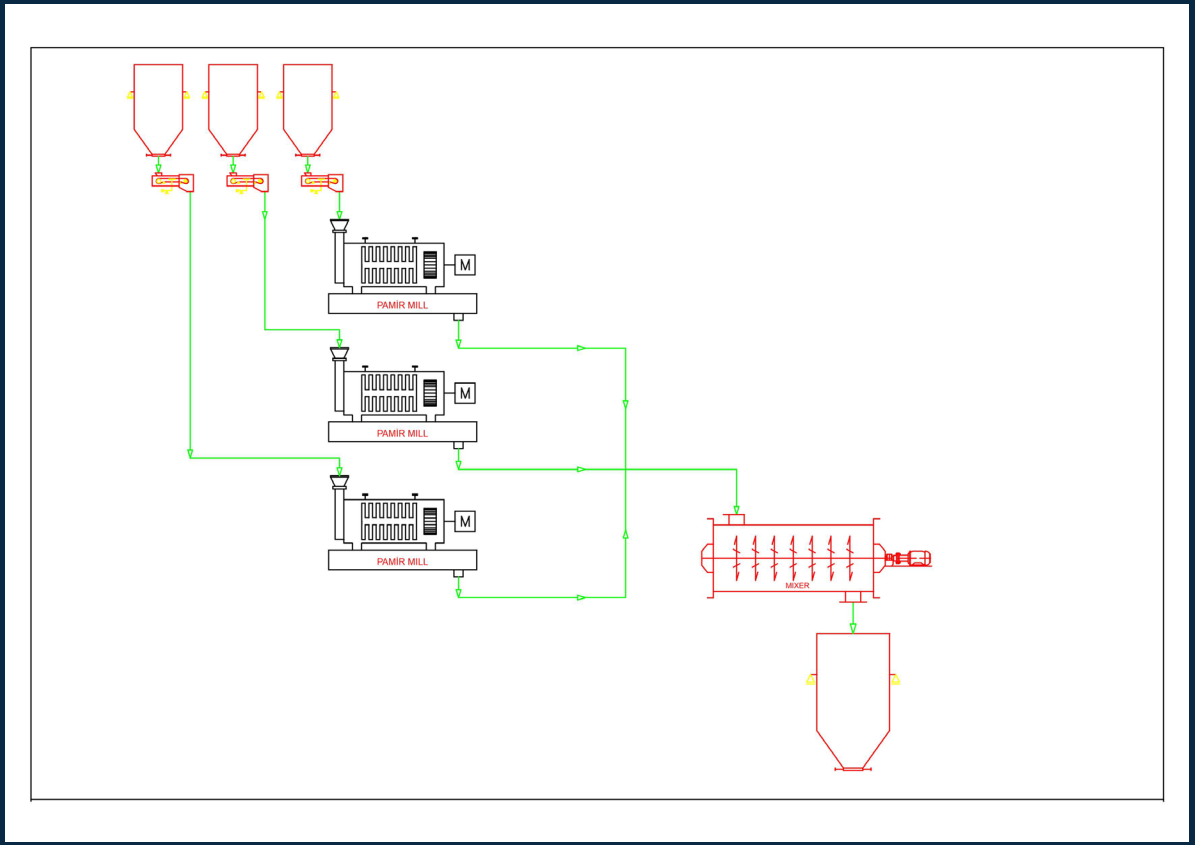
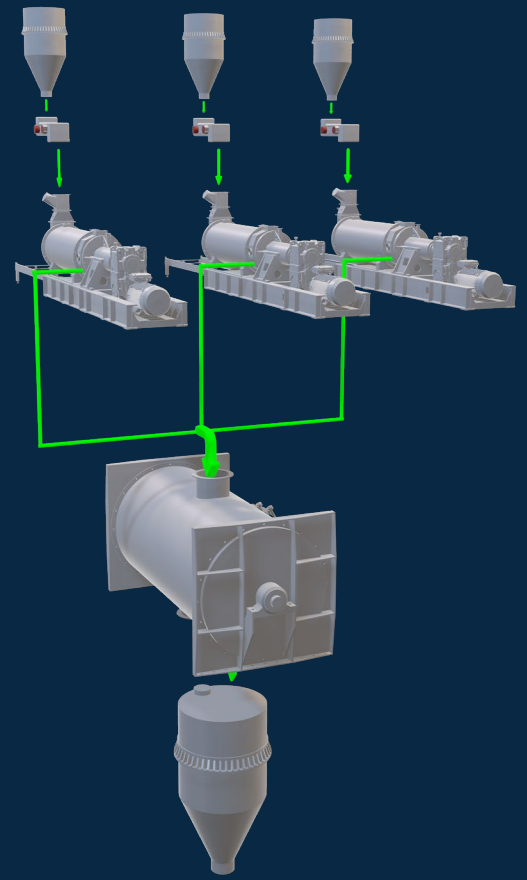
APPLICATION FIELDS - SEPARATE GRINDING





MINERVA WORKING METHODOLOGY

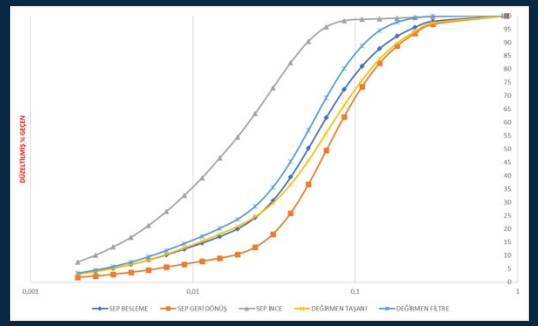
Measure → Evaluate → Simulate → Pilot Test Run → Performance Guarantee

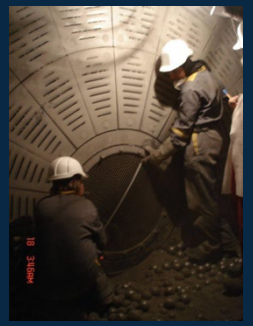
ENERGY

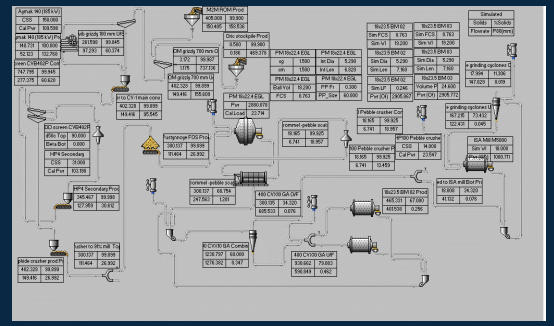
QUALITY

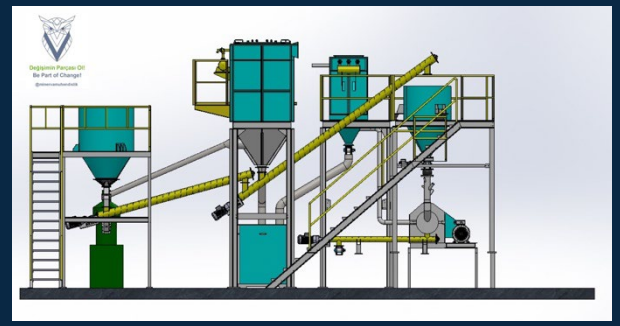
CAPACITY

CLINKER FACTOR









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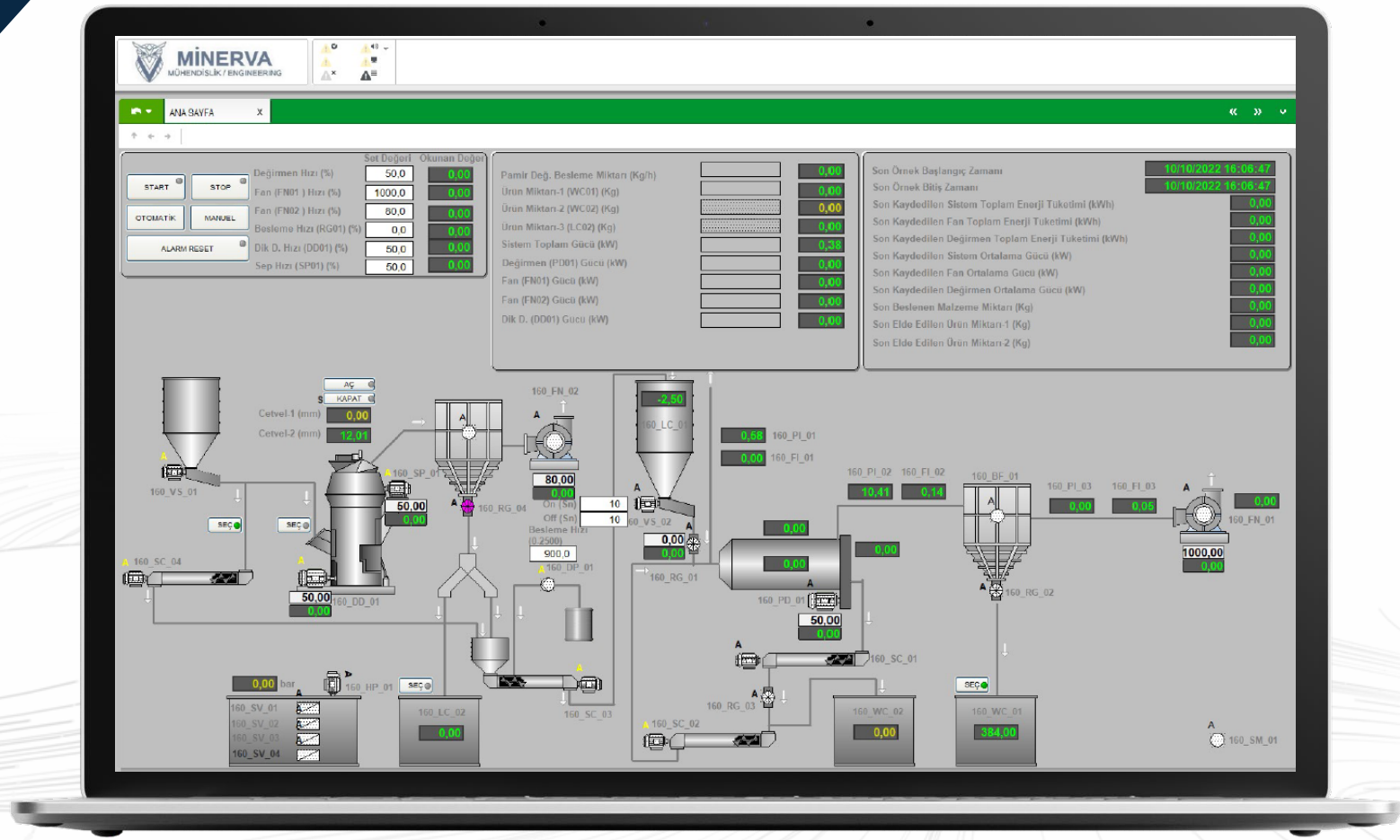
TESTING PROCEDURE

TEST PARAMETERS

- Tip speed
- Feed capacity
- Ball charge
- Ball type (ceramic, steel)
- Ball size
- Disk types

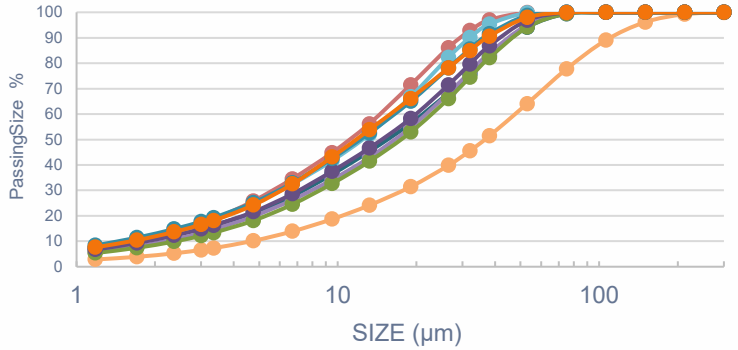
TEST OUTCOMES

- Energy consumption
- Quality improvement
- Additive maximization

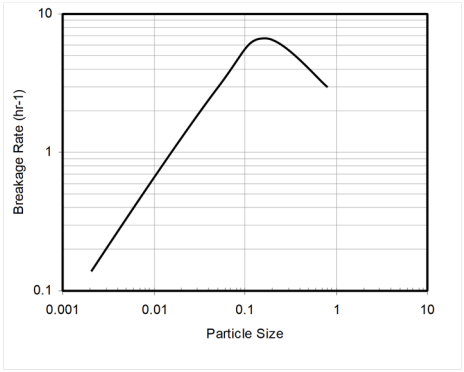


PAMIR SIMULATION STUDIES

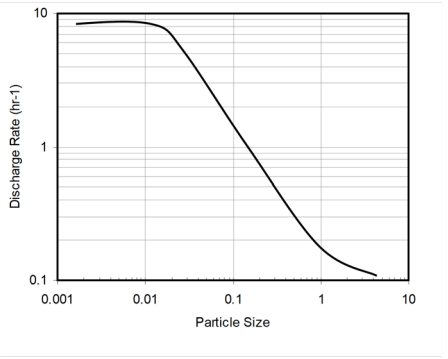
Partical Size Distributions



Breakage Rate



Discharge Rate



AVAILABLE MODELS

- BALL MILL
- AIR SEPARATOR
- ROLLER PRESS
- VERTICAL MILL

Industrial Data Set + **Pilot Plant Data Set** =

Optimum Conditions

- Ball Size
- Tip Speed
- Ball Charge
- Feeding Size
- Ball type
- Grinding Aid Dosage

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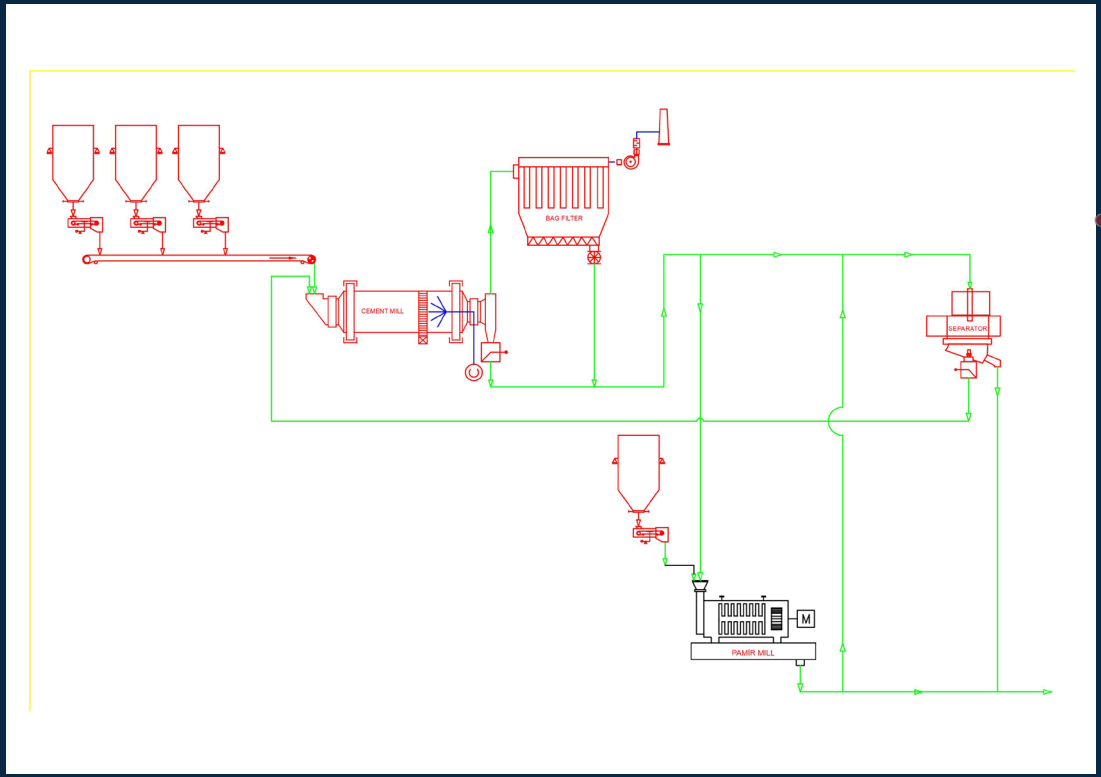
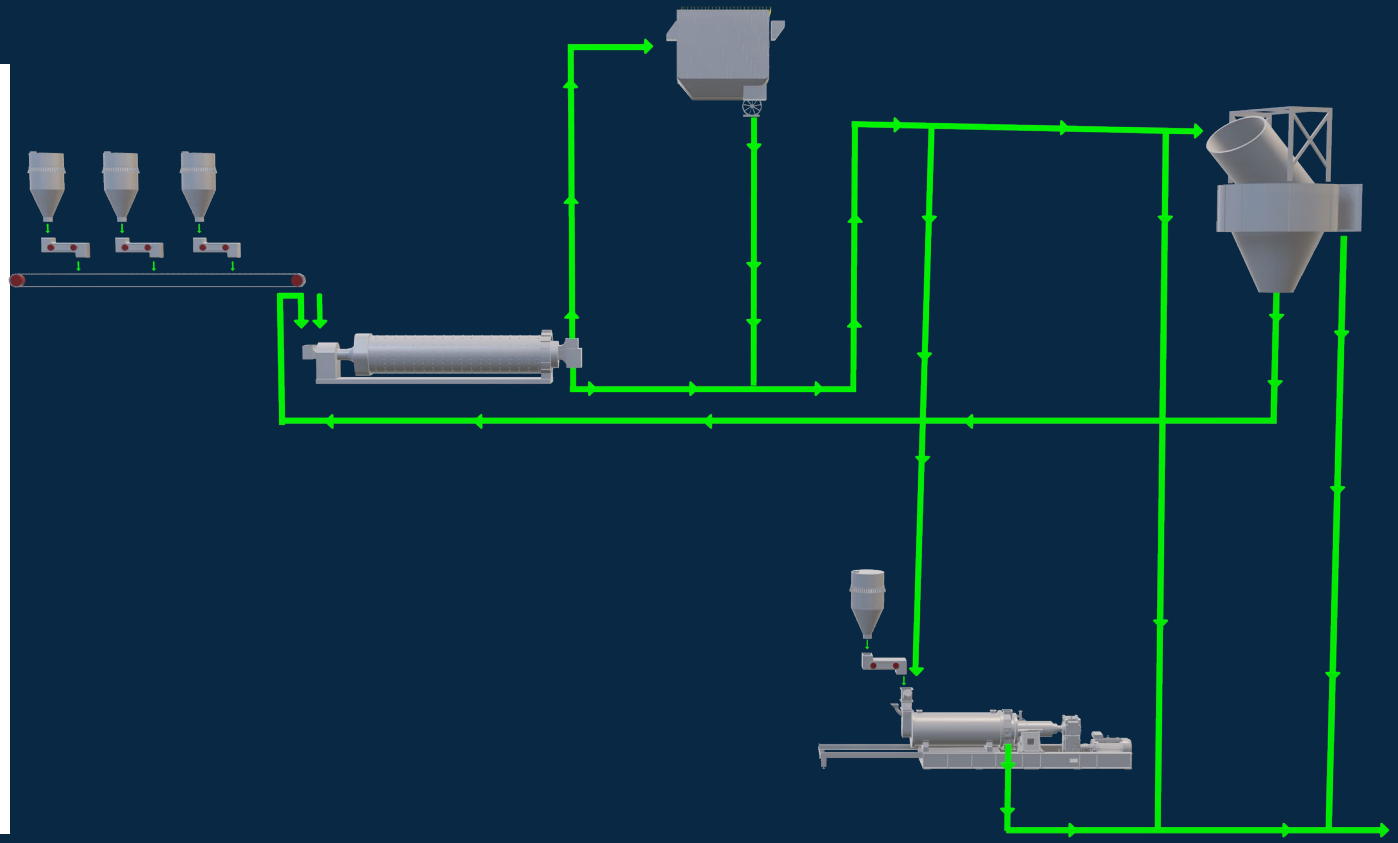
INDUSTRIAL RESULTS BURSA CEMENT PLANT

Bursa Cement Plant	Application Field	Capacity Increase	Energy Consumption Saving
1000	Gray cement	%22	%16





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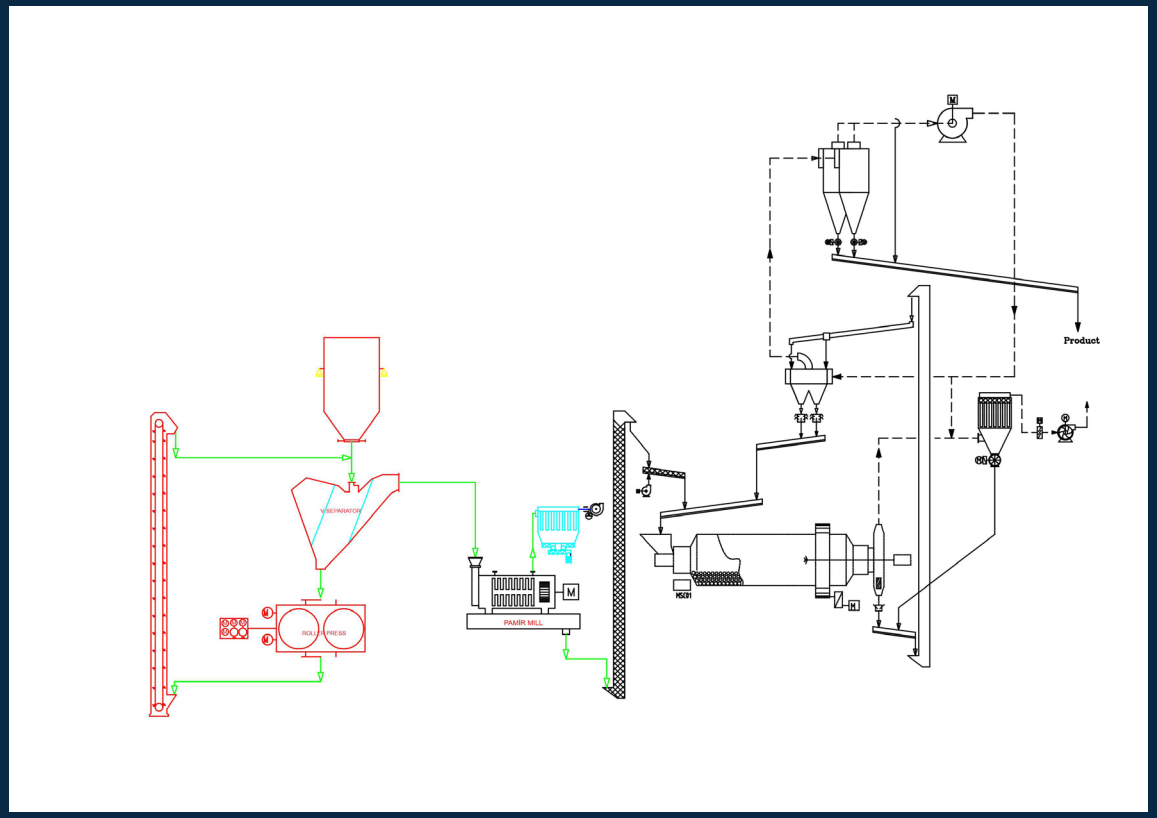
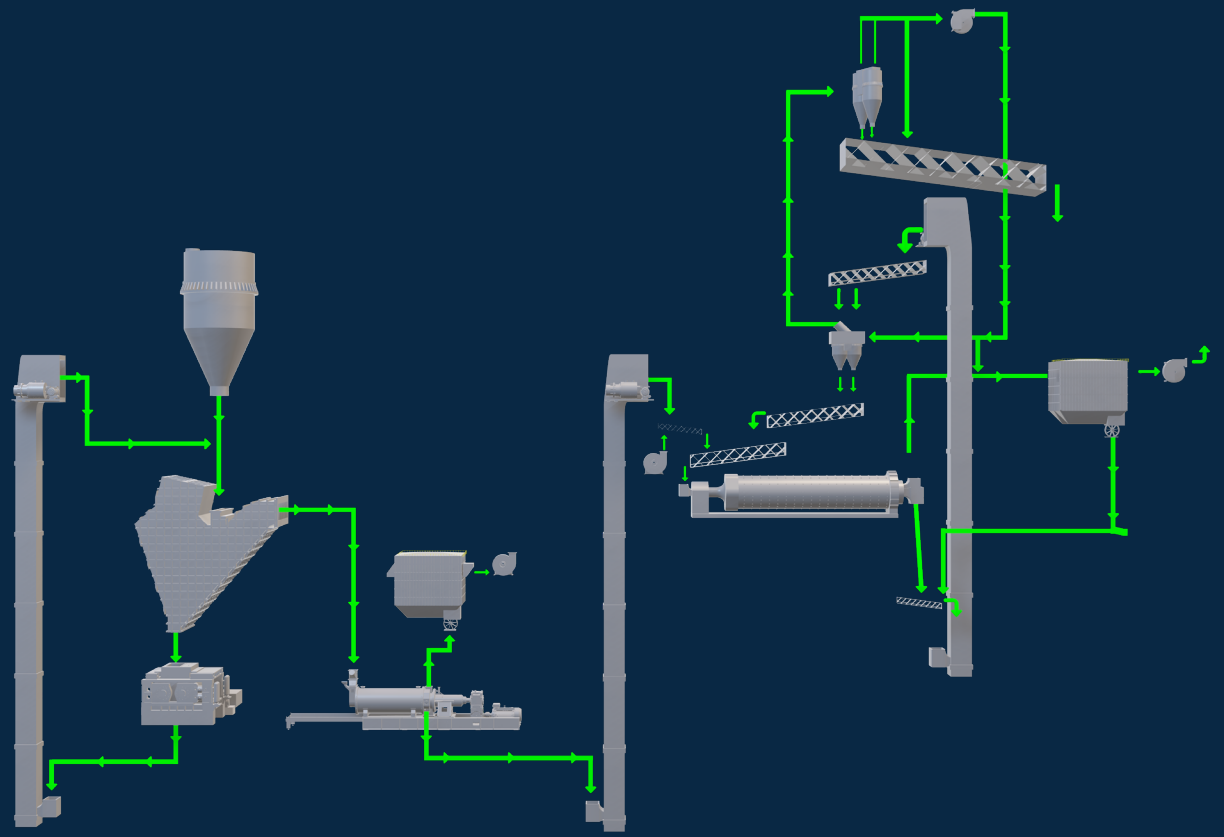
INDUSTRIAL RESULTS ADANA CEMENT PLANT

Adana Cement Plant	Application Field	Capacity Increase	Energy Consumption Saving
3000	White cement	%25	%10





*according to contract bonds

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INDUSTRIAL RESULTS

Easy Operation

Operator Behavior

Easy Maintenance

Wear Observations

Challanges

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Energy
Consumption
Decreasing

Additives
Maximising
Utilisation

Special
Cement
Production

Quality
Management

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THANKS

BE PART OF CHANGE!

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