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Pyrolysis Unit

Technical Specifications

Manisa Water and Sewerage Administration

General Directorate

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1. Technical Specifications

1.1 General description

The pyrolysis unit is designed for the thermochemical conversion of sewage sludge under controlled conditions, enabling the production of solid (biochar), liquid, and gaseous products. The system operates in an absence of oxygen environment and allows precise control of key process parameters, such as temperature and residence time, in order to ensure stable and reproducible operation.

The unit will consist of the following main components: (i) the feeding system, comprising an automatic feeding mechanism with the capability to operate in either continuous or intermittent mode, with a minimum feed: 75 kg/hour for continuous operation; (ii) the reactor, equipped with adjustable operating temperature control (e.g., within the range of 500 to 800 °C); and (iii) the syngas cleaning system.

Below are the desired technical characteristics of the pyrolysis unit.

1.2 Electrical Supply & Electrical Panel

Each Organization/Company shall provide the installation of three-phase electrical power at the location of the pyrolysis unit, depending on the specific requirements of the unit. The electrical panel of the machine shall be the responsibility of the supplier. Finally, the supplier shall provide the electrical panel together with an electricity consumption meter.

The pyrolysis unit shall be designed to operate with 380–400 V, 50 Hz, three-phase electrical supply. The contractor shall provide the main power supply, electrical distribution and grounding systems completely. All electrical installations shall comply with TS HD 60364 and related standards.

The main electrical and automation panels shall be supplied by the contractor and shall have at least IP54 protection class.

The electrical panels shall include the following components:

- Main switch, MCCB and fuse groups
- Motor protection switches and contactors
- Frequency converters
- 24 V DC power supplies
- Industrial Ethernet switch
- Energy analyzer / electricity consumption meter
- Relays and terminal blocks

PLC, SCADA and communication systems shall be powered through a UPS system to ensure operational continuity. In case of power failure, the system shall perform a controlled shutdown procedure.

The total electricity consumption of the unit shall be measured via an energy analyzer installed in the panel and monitored through the SCADA/HMI system.

1.3 Certifications (CE)

The Pyrolysis Unit must be CE certified.

1.4 *Guaranties*

A range of guaranties will be required, regarding materials and parts, 24 months for moving parts and 5 years for materials and accessories. In the event of a problem, the contractor should be able to send a skilled craftsman after notification by the Organization/Company within a maximum of 36 hours or in consultation with the responsible persons.

1.5 *Technical Information*

1.5.1 *Continuous Operation and Operating volume*

The pyrolysis unit shall be designed to operate either in continuous mode. For a continuous reactor configuration, the unit shall be capable of processing a minimum feed rate of 75 kg per hour. The selected type of reactor shall ensure stable process conditions, reliable performance, and consistent quality of the produced products, in accordance with the technical requirements of the system.

1.5.2 *Minimum and Maximum Operating Temperatures*

The pyrolysis unit is specified to operate at a temperature that must be at least 500°C and must not exceed 800°C. Maintaining this temperature range is required to ensure the complete release of gas and vapor fractions during the pyrolysis process. The unit must ensure thorough thermal decomposition of the feedstock while maintaining safe and stable operation.

1.5.3 *Reactor and other components material*

All critical components of the pyrolysis unit, including the reactor, feeding system, condenser (optional), syngas cleaning system, extraction system, and gas pipes, must be made of stainless steel. The reactor must have a minimum resistance to operating temperatures of 1050°C, while all other components that come into contact with the processed medium must meet at least stainless steel grade EN 1.4301. This ensures durability, chemical resistance, and safe operation under high-temperature and corrosive conditions throughout the unit. The condenser and syngas cleaning system are optional components; when included, all parts in contact with the processed medium must be made of stainless steel, minimum grade EN 1.4301.

1.5.4 *Ability to measure produced syngas gas*

The pyrolysis unit must be equipped with a system for sampling and cooling the produced syngas to allow condensation of humidity and oil. It must include sensors to measure the gas flow and composition, specifically for CO, CO₂, N₂, CH₄, and H₂, ensuring accurate monitoring and analysis of the syngas produced during the pyrolysis process

1.5.5 *Control*

The pyrolysis unit shall be equipped with a PLC-based automation system to ensure fully automatic and coordinated operation of the process.

The PLC shall control the following equipment:

- Feeding system motors
- Reactor and auxiliary motors
- Fans and pumps
- Burner and ignition system
- Safety interlocks

The PLC program shall include alarm management, fault detection, safety logic and emergency shutdown scenarios.

The system shall be monitored and controlled via industrial SCADA software. Through the SCADA interface:

- Temperature, pressure, flow rate and energy consumption shall be monitored
- Alarms and faults shall be recorded
- Process trends and operational reports shall be available

SCADA software licenses shall be perpetual.

The automation system shall support the following industrial communication protocols:

- Modbus TCP/IP
- Profinet
- Ethernet TCP/IP
- Fiber optic communication

All field devices shall be integrated with the PLC via industrial communication networks.

The following process parameters shall be measured using industrial-grade instrumentation:

- Reactor temperatures
- Reactor pressure
- Synthesis gas flow rate
- Exhaust gas flow rate
- Gas composition (CO, CO₂, CH₄, H₂, N₂)

The system shall allow remote monitoring and control, with user authorization and activity logging features. Remote access shall be provided via secure VPN infrastructure.

The control system shall include emergency stop buttons located at easily accessible positions for the operator. In case of any critical malfunction, the system shall automatically switch to safe mode and stop feeding and combustion processes.

1.5.6 Monitoring and Operation

The pyrolysis unit must include monitoring systems for key process parameters, specifically temperatures and pressures throughout the system. Additionally, the unit must support remote operation and monitoring, allowing operators to control and supervise the process safely and efficiently from a distance.

1.5.7 Input moisture

The pyrolysis unit must be capable of processing feedstock with a moisture content of up to 30%.

1.5.8 Retention time

For a continuous reactor, the pyrolysis unit must allow adjustment of the retention time of the feedstock, with a maximum capability of up to 1 hour, to ensure optimal thermal decomposition and process flexibility.

1.5.9 Burner

The pyrolysis unit must include a burner capable of burning the produced syngas, and it must be able to operate with liquid propane gas or natural gas during start-up. The system must also include measurement of the exhaust gas flow rate to ensure safe and efficient combustion and process control.

1.5.10 Emissions

The exhaust gases from the pyrolysis unit burner must comply with the following emission limits:

- Dust: 20 mg/Nm³,
- Nitrous oxides (as NO₂): 200 mg/Nm³,
- Sulphur oxide (SO₂): 100 mg/Nm³,
- Carbon monoxide (CO): 150 mg/Nm³,
- Total Organic Carbon (TOC): 20 mg/Nm³,
- Ammonia (NH₃) [*]: 5 mg/Nm³,

[*] This limit applies only if abatement systems using urea or ammonia are adopted for nitrogen oxides removal.

The system must ensure that all exhaust emissions remain within these limits to comply with environmental and safety standards.

1.5.11 Operating pressure

The pressure inside the pyrolysis reactor must be maintained 10–20 mbar above ambient pressure to ensure safe and stable operation of the unit while preventing ingress of air and maintaining optimal process conditions.

1.5.12 Feeding and extraction systems

The feeding and extraction systems must be designed to prevent any air from entering the reactor, ensuring an inert and controlled atmosphere for safe and efficient pyrolysis operation.

1.5.13 Noise Levels

In any case, noise levels should not exceed 80dB outside the settler area.

1.5.14 Staff training

The technical offer will set out the training program on the pyrolysis unit's operation and maintenance and its accessories. This program will begin with the receipt of the unit and will continue throughout its pilot operation with reference to local conditions as well. Simultaneously with the training will be the pyrolysis unit's demonstration of the operation and its accessories.

1.5.15 User and maintenance manuals

For pyrolysis unit, a user and maintenance manual will be provided in English and Turkish.

1.6 Unit Location

1.6.1 Installation's place

The pyrolysis unit will be constructed in the area designated by the administration at the Manisa (Central) Wastewater Treatment Plant.

Power supply

Each Organization/Company should provide a power installation at the location of each pyrolysis unit. The electrical panel of the machines and the energy consumption meter are the supplier's obligation.

1.6.2 Infrastructures

The supplier shall submit a basic installation layout, including complete dimensional information and spatial requirements. The submission of this layout shall be considered a mandatory deliverable of the supplier. Each unit should be accompanied by an appropriate electrical panel which will also contain an electricity consumption meter.

The fully developed unit should be designed to be installed in an area preferably not exceeding 50 m²

The pyrolysis unit should be accessible to Disabled People.

1.7 Plaque / Billboard

(For infrastructure and pilot installations)

Plaques or billboards shall comply with the following requirements:

- They shall include the official project logo.
- They shall be installed at the time physical implementation begins or when equipment purchase or supply commences.
- They shall be placed directly on the infrastructure/equipment or, where this is not feasible, in its immediate vicinity.
- They shall be of substantial size and made of durable, robust materials resistant to environmental

conditions.

- They shall be prepared in both the project language (English) and the local language (Turkish).
- They shall include:
 - The name of the equipment/infrastructure,
 - A brief description of its purpose,
 - A brief project description (ideally not exceeding 400 characters), where space permits,
 - The project website address or a QR code.

Where additional logos are displayed, the EU emblem (as included within the project logo) shall be at least as large as the largest of the other logos.

1.7.1 Stickers / Labels

(For consumables and small equipment, e.g., computers, control panels, small tools, etc.)

All purchased tools, consumables, small equipment (including computers), and similar items shall be visibly labelled.

Labels shall include:

- The official project logo,
- The wording: **“Provided by the European Union – Interreg NEXT MED Programme”** (in EN / FR / AR, as applicable).

Labels shall preferably be affixed directly to the item in the form of an adhesive sticker.

No specific template is mandatory; however, the recommended dimensions are:

- 90 × 50 mm (for small items),
- 100 × 100 mm (for large items).

All labels shall be durable and resistant to wear, fading, and environmental conditions

2 Evaluation criteria

2.1 Award criterion

The award criterion of the Contract is the most economically advantageous tender based on an optimal value-for-money relationship, assessed on the basis of the following criteria:

The group of Criteria for the Evaluation of Technical offer has a weighting of 70% and the assessment of the economic offer has a weighting factor of 30%. (S1 = 70% and S2 = 30%).

2.2 Scoring

Criterion	Criterion description	Weighting factor (σi)
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K1	Operating volume of pyrolysis unit	70%
K2	Guarantee	25%
K3	Condenser	5%
Total of weighting factors		100%

Evaluation criteria	Weighting factor
<p>K1. Operating volume of Pyrolysis Unit</p> <hr/> <p><u>MINIMUM REQUIREMENTS</u> Operating volume pyrolysis unit 75 kg/h Rating = 100</p> <p><u>OVERLAP</u> Operating volume Pyrolysis unit more than 75 kg/h up to 100 kg/h Rating = 110 Operating volume Pyrolysis unit more than 100 kg/h Rating = 120</p>	70%

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K2. Guarantee (moving parts)	25%
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<p><u>MINIMUM REQUIREMENTS</u> 24 months Rating = 100</p> <p><u>OVERLAP</u> More than 24 months to 36 months Rating = 110 More than 36 months Rating = 120</p>	
K3. Condenser	5%
<p><u>MINIMUM REQUIREMENTS</u> Condenser stainless steel grade EN 1.4301 Rating = 100</p> <p><u>OVERLAP</u> stainless steel grade EN 1.4845 Rating = 120</p>	

Criteria with a score of less than 100 points (not covering / presenting deviations from the technical specifications of the present) result in rejection of the offer.

The total rating of the technical offer is calculated based on the following formula:

$$TST = \sigma 1 * K1 + \sigma 2 * K2 + \sigma 3 * K3$$

The rating of the financial offer is based on the formula:

$$TSF = [(SB - PO) / SB] * 100$$

Where

SB = service budget in € (i.e. the maximum budget available for the service as specified in the tender documents) and

PO = the total price of the offer.

The most advantageous offer based on a weighting factor for both technical and financial offer is the sum of:

$FL = 100 * [(TST * S1) + (TSF * S2)]$ where the FL is the final rating, the TST the total score of the technical offer and the TSF the total score of the financial offer.

The rating of each evaluation criterion ranges from 100 points where exactly fulfilled all terms of technical specifications, increasing it to 120 points when the overlapping requirements of this criterion.

Each rating criterion is graded autonomously on the basis of the offer details.

The weighted score of each criterion will be determined by multiplying the individual weighting factor for the score and the total score of the offer will result from the sum of the weighted scores of all criteria.

2.3 Table of conformity – Technical Specifications

This paragraph presents the table of conformity proposed in the tender documents for Pyrolysis Unit. In particular, the following will be described:

The Applicant Contractor completes the following tables of compliance with the absolute responsibility for the accuracy of the data. Where the requested quantity is not explicitly stated, the Contractor will propose, based on the capabilities of its products and services.

In the column "SPECIFICATION", the corresponding technical terms obligations or explanations for which corresponding answers should be given are described in detail.

In the "REQUEST" column, the word "YES" has been completed, meaning that the corresponding specification is mandatory for the Contractor against a foreclosure penalty deemed to be an unfavorable term in accordance with this declaration. Tenders that do not cover fully unfavorable terms are rejected as unacceptable.

If the "REQUEST" column is not filled with the word "YES" or a number, then the specification is desirable and not mandatory. Tenders that do not cover or deviate from non-mandatory terms are not discarded.

In the "ANSWER" column, the Contractor's answer is in the form of YES / NO if the corresponding specification is filled or not or is overlapped by the offer or a numerical size indicating the quantity of the corresponding feature in the offer. A simple statement or explanation is not proof of fulfillment of the specification and the assessment committee has the obligation to verify and confirm the claim.

In the "REFERENCE" column, the clear reference to a corresponding manufacturer's technical brochure or a detailed technical description of the software or service equipment or interface and operation, or installation, support and training methodology, etc., will be recorded which will be listed in a corresponding annex to the technical offer.

In case that any term of the tables is not answered then the answer is considered negative.

A/A	Specification	Minimum Requirements	Demand	Answer	Reference
1	Continuous Operation	Minimum feed: 75 kg/hour for continuous operation or	YES		
2	Minimum Operating Temperature	500 °C	YES		
	Maximum Operating Temperature	800 °C			

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3	Reactor Material	Stainless steel with a minimum resistance to operating temperatures of 1050°C	YES		
4	Feeding System	Minimum material quality for components in contact with the processed medium: stainless steel grade EN 1.4301	YES		
5	Condenser (optional)	Minimum material quality for components in contact with the processed medium: stainless steel grade EN 1.4301	No		
6	Syngas Cleaning System	Minimum material quality for components in contact with the processed medium: stainless steel grade EN 1.4301	YES		
7	Extraction System	Minimum material quality for components in contact with the processed medium: stainless steel grade EN 1.4301	YES		
8	Gas Pipes	Minimum material quality for components in contact with the processed medium: stainless steel grade EN 1.4301	YES		
9	Ability to measure produced syngas gas	Syngas sampling and cooling for humidity/oil condensation; flow and gas composition (CO, CO ₂ , N ₂ , CH ₄ , H ₂) sensors.	YES		
10	Control	Electronic control via PLC of: <ul style="list-style-type: none"> - Motors - Pumps - Ventilation - Burner 	YES		
11	Monitoring	<ul style="list-style-type: none"> - Temperatures - Pressures 	YES		
12	Operation and Monitoring	Remote Control	YES		

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13	Total Required Area	The fully developed unit must be designed for deployment within an area preferably not exceeding 50 m ²			
14	Input moisture	Up to 30%	YES		
15	Retention time	In the case of continuous reactor, the possibility to modify the retention time up to 1 hour	YES		
16	Burner	Produced syngas must be burnt in a burner able to accept both syngas and liquid propane gas/natural gas for start-up. Measure of the exhaust gases flow rate.	YES		
17	Emissions	Exhaust gases from the burner must comply with: Table 1 – Emission limits assumed for the syngas burner emissions. Dust: 20 mg/Nm ³ Nitrous oxides (as NO ₂): 200 mg/Nm ³ Sulphur oxide (SO ₂): 100 mg/Nm ³ Carbon monoxide (CO): 150 mg/Nm ³ Total Organic Carbon (TOC): 20 mg/Nm ³ Ammonia (NH ₃) [*]: 5 mg/Nm ³ [*] It applies in the case where abatement systems using urea or ammonia are adopted for nitrogen oxides removal.	YES		
18	Operating pressure	The pressure inside the reactor must be kept 10-20 mb higher than the ambient pressure	YES		
19	Feeding and extraction systems	Must be able not to let any air into the reactor	YES		
20	Noise	< 80 dB	YES		

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21	Design of Installation	The submission of a basic installation layout (including complete dimensional information and spatial requirements) shall be considered a mandatory deliverable of the supplier	YES		
22	Power consumption meter, electrical panel and education	The supplier shall install a power consumption meter and the main electrical control panel, and shall provide full operator training	YES		
23	Access to people with disabilities	-	YES		
24	Staff training	-	YES		
25	User and maintenance manual in English and Turkish.		YES		