

Let's change together the future of Biomethane!

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

Organic solvents	0	kg/d
Active carbon	Related to ppm H ₂ S/gas flow at the inlet	kg/d

- ¹ In accordance with clients/local legislation requirements. Higher % CH₄ slightly increases the el. energy demand.
- ² Amount of methane in the offgas (waste gas) relative to the amount of methane in the raw biogas.
- ³ Only valid if the maintenance contract is concluded, see point 4.1.2.
- ⁴ El. Consumption in accordance with the plant size and years season (it's higher in summer)
- ⁵ According to the size of the plant and H₂S-value (ppm) at the inlet. We automatically assume the application of our preliminary raw biogas pre-treatment system, what is supposed to have as result the absolute elimination of sulphur and low demand on water exchange.

2. Gas quality (inlet/outlet)

2.1 Raw Biogas Requirements (inlet)

Parameter	Value	Unit
CH ₄	50-70	%
CO ₂	30-50	%
H ₂ S *	0-1000	ppm
H ₂ **	< 0,1	%
O ₂ + N ₂ **	< 0,5	%
Siloxanes and terpenes	see point 2.3	ppm
Inlet temperature ***	5-55	°C
Inlet pressure	accord. to project	Mbar
Relative humidity	≤ 100	%

* BriMex automatically assumes the application of our preliminary raw biogas pre-treatment unit (BTU). According to ppm inlet value the active carbon consumption (kg) will be stated. BTU is able to economically effectively desulphurize the biogas until 1000 ppm H₂S max. Even during BTU dropout our pressurized water scrubber is fully functional without the risk of damage or capacity restriction – it will wash out into process water the H₂S until 1000 ppm at the inlet. An increased ratio of H₂S at the inlet to plant compressor can influence a higher maintenance demand and a more frequent process water exchange plus an increased H₂S concentration in the waste gas (offgas).

** Amount of H₂, O₂, N₂ at the inlet affects the final quality of biomethane, respectively % CH₄ because these substances will be not eliminated during the washing/scrubbing process.

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

*** Regarding the inlet temperature we admit the client the option to vary in the stated gap, because BriMex automatically assumes the application of our preliminary raw biogas pre-treatment unit (BTU). BTU includes a biogas chiller, this why it's not necessary to set a limit for biogas temperature to 40°C, to avoid a capacity decrease of the plant. BTU will chill the biogas in the proper way in terms of the process requirements.

2.2 Biomethane - product gas specifications (outlet)

Parameter	Value	Unit
CH ₄ ^A	95-98	%
CO ₂	1-4	%
H ₂ S ^B	0	ppm
H ₂	corresponding to inlet	%
O ₂	corresponding to inlet	%
N ₂	corresponding to inlet	%
Outlet pressure	5-8	bar
Outlet temperature	10-30	°C
Dew point ^C	-40 °C at 4 bar, or < 50 mg/Nm ³	

^A In accordance with the legislative requirements of the particular country and of the chosen application method. At higher %-CH₄-values occurs a slightly higher energetic demand of the process.

^B Brimex automatically assumes the application of our preliminary raw biogas pre-treatment unit (BTU), with a desulphurization included as well. Preliminary desulphurization prevents the H₂S to enter the scrubbing process of the plant. Pre-elimination of H₂S advantages: even higher stability of pH-level and a less often water exchange, no H₂S in the offgas, in a long term horizon no risk of elementary sulphur deposition, a general saving of all involved components from the maintenance point of view.

^C The setting of the biomethane humidity limit depends on legislation restrictions of the particular country.

2.3 Siloxanes and terpenes

λ-sensors (O₂) in vehicles or combustion engines etc. are very vulnerable for deposits of silicon dioxide. There elimination is therefore needed before the biogas enters the scrubbing process. It is possible to integrate an additional siloxane-filter as an option into our raw biogas pre-treatment unit (BTU).

Terpenes (concentration ranging in specific biogases 0-200 ppm) can lead to objectionable gas odour already from 2 ppm and higher. Terpenes are a compound of ethereal oils, extracted from different parts of herbs/plants via water steam distillation, pressing or proper solvents. F.e. if citrus

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

fruits/plants (hesperidium) are used as substrate for the particular biogas plant it's necessary to identify those and quantify in advance.

3. Technology description

3.1 General description

The technical solution of Brimex type STABLE represents an optimized technology of a pressurized water scrubber for biomethane production.

The technology uses different soluble qualities of undesirable biogas substances in process liquid (drinking water) – particularly carbone dioxide, hydrogen sulphide and ammonia – compared to methane water solubility.

At different temperature and pressure (f.e. at pressure of 1 bar and temperature of 25°C) CO₂ achieves a 25- times higher water solubility like methane, H₂S almost 80- times higher and NH₃ even 20.000- times higher water solubility as methane.

By passing the process environment at an increased pressure the process water saturates by CO₂, H₂S (if present due to pre-treatment) and NH₃, while methane passes the process without process water reaction – increase its volume in the product gas. To increase the ability of process water solubility we use isotropic packing elements with large surface to increase the contact surface between absorption fluid and gas.

Different to systems which can be suitable for small gas flows and clean/predictable biogas become these unpredictable/unstable using biogas with varying gas composition - ergo systems running in a fixed regime with a limited flexibility. On the other hand a pressurized water scrubber automatically changes the parameter settings as pressure, water flow, gas circulation to maintain the quality despite of changing gas composition/flow. The process is resistant against negative actions of different contaminants, like dust particles etc.

Our system does not need a complete reinvestment after 7-8 years (like membranes) in terms of the core-system-scrubbing-chambers and does not depend on a specialized/monopoly delivery of the scrubbing chambers or agents (special chemicals etc.)!

Innovations of the pressurized water scrubber by GASTanco Ltd.:

- ✓ **Our system automatically controls/pre-treats/adjusts the inlet mediums – biogas + water. This way we generate a safe environment in the columns without the risk of microbiological growth, elementary sulphur layers creation, to frequent water exchange & maintenance intervals compared to other pressurized water scrubbers. We don't shift the responsibility for this important point to the client. We still keep the advantage of letting a**

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

non pre-treated biogas in (f.e. 1000 ppm H₂S etc.), but we reserve this option for the case when the pre-treatment is out of order so we can still continue in operation, maintain availability of the plant.

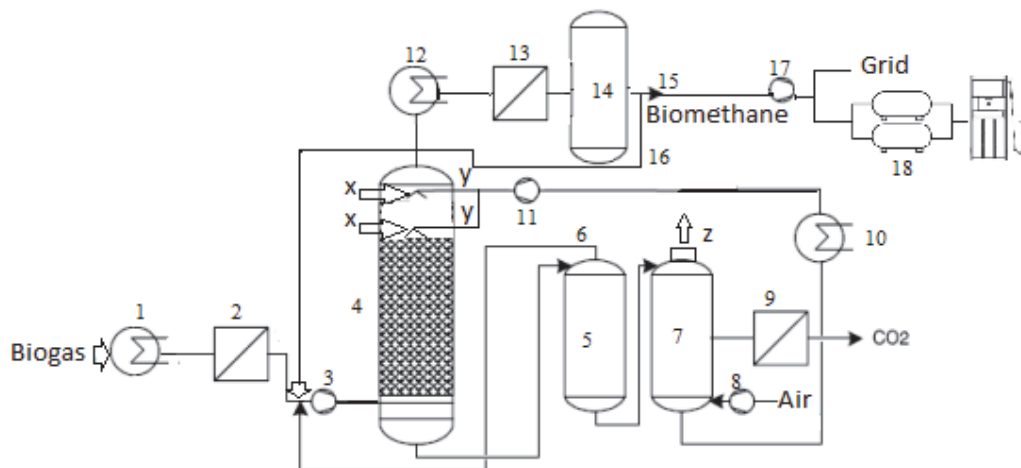
- ✓ Furthermore we started the evolution of the absorption column and bring the 2nd generation into life with a multilevel water injection – a more homogenous water fog generation with higher volume yield of the absorption column and safety due to more spraying water points.
- ✓ Last but not least we implement a new philosophy for the instrumentation and control system of a pressurized water scrubber – removing the contra-productive purposeless sensor loops to make the system operation reliable & smooth – we simplify where it's productive to reduce potential failure components but use the sophisticated tools where the client can profit from it.

As inlet medium can be used: biogas produced by anaerobic digestion (AD), mine gas, sewage gas from WWTP, landfill gas, biogas from agricultural biogas plants, biogas from biological waste or biogas originating from other types of BGP.

Product gas, biomethane, is after the scrubbing process injected into the natural gas grid or adapted to a vehicle fuel – BioCNG or BioLNG.

3.2 Technical scheme (P&ID)

P&ID Brimex STABLE:



Plant consisting of the following parts:

1 Biogas cooling unit

BriMEX Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

2 Filter (with activated carbon)

1 + 2 create base of raw biogas pre-treatment unit (BTU). BTU is equipped with a condensate trap, if necessary with a heat exchanger or blower for reheating plus is completely set up and connected to the plant central control (monitoring, orders).

3 Compressor. Compresses the pre-treated biogas to a pressure set point and blows it into the absorption column.

4 Absorption column. CO₂-separation takes place in the absorption column where at the contact surface (packing elements) inside of the column where the contact between the inside pumped process water under pressure and compressed biogas which is blown inside takes place in a counter-flow. There are two spraying nozzles X positioned in the absorption column and the process water is sprayed in two different levels Y. As result we create a much more homogenous water fog with a higher density.

5 Second stage separation column. In the second stage separation column takes the separation of residual methane place under pressure decrease. The purpose is to take out the part of methane which was undesirably captured by the process water and pumped into the second stage separation column.

6 Outlet for residual methane. Residual methane is piped from the second stage separation column in front of the compressor to be recycled in the system.

7 Desorption column. CO₂ is extracted from the process water by pressure decrease to a necessary set point and through contact made on surface of the packing elements between process water and blown air (blower 8) in a counter-flow. The offgas (waste gas) is leaving the column through exhaust chimney Z.

8 Air blower.

9 Demister for water droplets removal (to dismantle the water droplets from the offgas while leaving the column via the exhaust chimney)

10 Process water cooling unit (+ inlet water pre-treatment). The process water is cooled if needed (due to settings).

11 Circulation pump. Process water is pumped under increased pressure into the absorption column where it is reused for the methane separation from the biogas (water recycling).

12 Biomethane cooling unit.

13 Rotation droplet eliminator.

14 Biomethane drying unit. Redundant execution (by-pass): two separated biomethane dryers are installed to achieve the required stage of dryness 24/7.

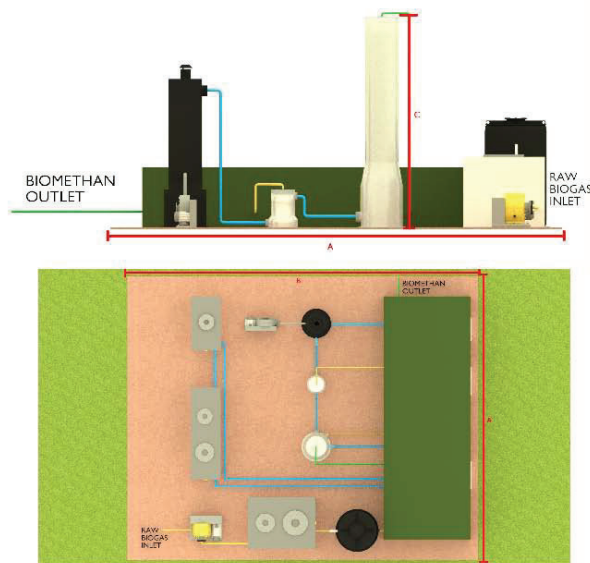
15 Central biogas/biomethane analysis and outlet of suitable biomethane. Measures **continuously (not just by deducing** from the CO₂-volume in biomethane) the volume of CH₄, O₂, CO₂ and H₂S (discontinuously) and the humidity of biomethane as well. The biogas analysis is done before it enters the BTU and after it leaves it. It evaluates the biomethane quality and monitors the outlet of the suitable biomethane – revises if the outgoing biomethane is in accordance with the criteria of the quality settings.

16 Outlet of the unsuitable biomethane back in front of the compressor. Is realised via a by-pass in front of the compressor. In case of a positive result of the analysis is the outgoing biogas classified as full-valued biomethane and is ready for the use, application.

17 Compressor station. Option. Delivers the necessary pressure-increase suitable for the natural gas grid injection or CNG. We can prepare a suitable quotation and deliver the station included into a turnkey solution with a turnkey system warranty.

18 Filling station. Option. We can prepare a suitable quotation and deliver the station included into a turnkey solution with a turnkey system warranty. We are able to deliver a complete fuel filling station for CNG including the gas storage, fuel dispensing pump, payment terminal etc. (eventually a LNG-station).

3.3 Dimensions



BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

Example of a possible layout – final details will be precisely designed in accordance with the particular project. The manufacturer is reserving the right to apply the actual state of development and for technical changes.

4. Scope of supply

TYPE: STABLE 1

Parameter	Value	Unit
<i>Parameters</i>		
Inlet – raw biogas	50-100	Nm ³ /h
Outlet – biomethane ¹	27-55	Nm ³ /h
Power supply	400 / 50 / 315	V/Hz/A
Installed el. power	approx. 145	kW
Power requirement el. ²	approx. 25	kW _{el}
Specific consumption el. ²	approx. 0,25	kWh /Nm ³ biogas
<i>Dimensions</i>		
Foundation plate of plant	approx. 7(A) x 12(B)	m
Highest point, absorption column	approx. 9(C)	m

¹ At 55% CH₄ in raw biogas (no temperature restriction), 97% CH₄ and 2% CO₂ in the outgoing biomethane.

² At 100% load of the plant and surrounding temperature of 50%, constant pressure at the inlet 20 mbar (g), operating pressure of 6 bar (g), outside temperature of 8°C, raw biogas-T at inlet of 20°C, >2% CO₂ in biomethane at outlet with 96-98% CH₄.

TYPE: STABLE 2

Parameter	Value	Unit
<i>Parameters</i>		
Inlet – raw biogas	75-200	Nm ³ /h
Outlet – biomethane ¹	41-111	Nm ³ /h
Power supply	400 / 50 / 315	V/Hz/A
Installed el. power	approx. 160	kW
Power requirement el. ²	approx. 50	kW _{el}
Specific consumption el. ²	approx. 0,25	kWh /Nm ³ biogas
<i>Dimensions</i>		
Foundation plate of plant	approx. 7(A) x 12(B)	m
Highest point, absorption column	approx. 9(C)	m

¹ At 55% CH₄ in raw biogas (no temperature restriction), 97% CH₄ and 2% CO₂ in the outgoing biomethane.

² At 100% load of the plant and surrounding temperature of 50%, constant pressure at the inlet 20 mbar (g), operating pressure of 6 bar (g), outside temperature of 8°C, raw biogas-T at inlet of 20°C, >2% CO₂ in biomethane at outlet with 96-98% CH₄.

TYPE: STABLE 3

Parameter	Value	Unit
<i>Parameters</i>		
Inlet – raw biogas	100-300	Nm ³ /h
Outlet – biomethane ¹	55-166	Nm ³ /h
Power supply	400 / 50 / 315	V/Hz/A
Installed el. power	approx. 175	kW
Power requirement el. ²	approx. 75	kW _{el}
Specific consumption el. ²	approx. 0,25	kWh /Nm ³ biogas
<i>Dimensions</i>		
Foundation plate of plant	approx. 10,5(A) x 13(B)	m
Highest point, absorption column	approx. 12(C)	m

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
 Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

¹ At 55% CH₄ in raw biogas (no temperature restriction), 97% CH₄ and 2% CO₂ in the outgoing biomethane.

² At 100% load of the plant and surrounding temperature of 50%, constant pressure at the inlet 20 mbar (g), operating pressure of 6 bar (g), outside temperature of 8°C, raw biogas-T at inlet of 20°C, >2% CO₂ in biomethane at outlet with 96-98% CH₄.

TYPE: STABLE 4

Parameter	Value	Unit
<i>Parameters</i>		
Inlet – raw biogas	240-500	Nm ³ /h
Outlet – biomethane ¹	138-277	Nm ³ /h
Power supply	400 / 50 / 315	V/Hz/A
Installed el. power	approx. 250	kW
Power requirement el. ²	approx. 120	kW _{el}
Specific consumption el. ²	approx. 0,24	kWh /Nm ³ biogas
<i>Dimensions</i>		
Foundation plate of plant	approx. 10,5(A) x 13(B)	m
Highest point, absorption column	approx. 12(C)	m

¹ At 55% CH₄ in raw biogas (no temperature restriction), 97% CH₄ and 2% CO₂ in the outgoing biomethane.

² At 100% load of the plant and surrounding temperature of 50%, constant pressure at the inlet 20 mbar (g), operating pressure of 6 bar (g), outside temperature of 8°C, raw biogas-T at inlet of 20°C, >2% CO₂ in biomethane at outlet with 96-98% CH₄.

4.2 Scope of supply*

The Brimnex system for biogas to biomethane upgrading is based on the principle of a pressurized water scrubber. Consisting of:

- **Raw biogas pre-treatment unit (BTU)** before the biogas enters the scrubber itself (during dropout the scrubber is fully functional). Consists of biogas chiller for anorganic acids removal for plant protection + regulates the inlet T of biogas to a suitable process level, condensate trap, a heat exchanger or a blower for reheating and reduction of the relative humidity, activated

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

carbon filter made of PE. Sensors with outgoing signals to the central gas analysis unit & control system for measuring the inlet/outlet parameters into/out of BTU (pressure, flow, temperature, CH₄, O₂, CO₂, H₂S).

- **Inlet water pre-treatment** unit. Inlet biogas + inlet water control = safe process without microbiological growth in the columns.
- **Compressor/s** for biogas compression (1 or 2 pc), incl. all necessary sensors and valves.
- **Absorption column** for CO₂-separation of the 2nd generation with a multilevel water fog. Material of the column: stainless steel AISI 304 (1.4301, V2A). Incl.: gratings, isotropic filling material with large surface, sensors (level, pressure, flow).
- **Second stage separation column** for extraction of residual methane (methane slip reduction), which was captured in the process water. Material of the column: stainless steel AISI 304 (1.4301, V2A). Incl.: sensors (level, pressure, flow).
- **Desorption column** for CO₂-removal from the process water (optionally with a device for thermal decomposition offgas/CO₂ before releasing it into atmosphere). Material of the column: HDPE. Incl.: gratings, isotropic filling material with large surface, sensors (level, pressure, flow), demister for water droplets removal mounted on the exhaust chimney of the offgas, blower for the process air.
- **Cooling unit:** water/biogas/biomethane
- **Inlet water pre-treatment unit:** to adjust the inlet water quality for optimal scrubbing and helps to prevent the microbiological growth in the columns.
- **Circulation pump** for process water recycling
- **Biomethane drying** (incl. two separate redundant units)
- **Instrumentation & control.** Switchboard with a completely automatic control system of the plant process incl. an interface for remote monitoring (internet) with a graphical visualisation at a touch screen in the plant and possibility of remote: visualisation + change of process settings + monitoring + service. Analyses of: flows, pressures, temperatures, humidity, composition of gases, pH and T of process water. If necessary: adding of process water pH-regulating agent and anti-foaming substances.
- **Central gas analyses** - CH₄, O₂, CO₂, H₂S. Incl. the raw biogas before/after the BTU (before entering the compressor) and biomethane analyses.
- **Odorant station for natural gas.** The used substance will be in accordance with the legislation requirements of the installation country (methyl mercaptan, THT etc.).
- **Container** divided into 2 sections: explosive area and other equipment. Incl.: lighting, temperature regulation, ventilation.
- Whole plant **includes:** connection accessories incl. piping, flanges, valves to connect the delivered parts.
- **Lightning protection.** Is placed at the highest column (absorption). The price includes the connection points advance preparation suitable for connection to the clients grounding of STABILE + including the necessary lightning rods for STABILE. The connection points will be prepared on the corners of the container. The connection of the container to the grounding provides the client. The measurement of the diverter resistance and preparation of the protocol

about the measurement provides the client. If a lightning risk analysis of the site of installation is needed it will be provided by the client.

- **Thermal insulation** of the necessary parts to ensure a smooth operation during all seasons (like columns)
- **Documentation** (in electronic form, 1 x CD + 1 x in printed form)

***The manufacturer reserves the right to apply the current state of development and for technical changes.**

4.1 Options

4.1.1 Device for thermal decomposition of waste gas (offgas)

Desorption column releases offgas after the CO₂-separation from the process water (recycling) into the atmosphere. Client will submit to us the legislation requirements of the installation country, if there are some obligations regarding the emission limits. Optionally we can offer a device for thermal decomposition of waste gas before releasing it into the atmosphere, or just a filter with active carbon. Brimex automatically assumes the application of our preliminary raw biogas pre-treatment unit (BTU), with a desulphurization included. Therefore the entrance of H₂S and its water scrubbing is restricted - finally its emission via the exhaust chimney for offgas as well. According to that there will be no inappropriate smell or emission caused by H₂S.

4.1.2 Maintenance contract

Maintenance contract will be concluded minimally for the duration of 5 years and its price is 3% of the offer price for the total amount ex Works, p.a. (the maintenance price is annually adjusted by the annual inflation rate of the Euro-zone). It includes the consumables, the maintenance material (assumed spare parts) and necessary work as well (does not include the travelling costs and accommodation expenses). Service is done every 8400 h. If a shorter service period will be forced in violation of the responsibilities stated in the operation manual by the client – the expenses for these additional spare parts and work effort will be invoiced separately according to the actual costs. The maintenance contract includes remote monitoring of the plant settings by our company plus the proactive analyses of these data and if it's necessary – an alert through our employees if the data evaluation leads to a need for action of the operating staff at site. The price includes the possibility to use our 24/7 helpdesk hotline 365 d/p.a.

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx

4.1.3 Supervision

The supervisor will lead the finalisation mounting works at the site of installation and the 2-3 weeks lasting testing operation of the biomethane plant. The supervisor will carry out the training of the operating personnel of the client as well. The price does not include the travelling costs and accommodation expenses (will be invoiced in accordance with the real expenses).

4.1.3 Peripheral equipment

Optionally it is possible to offer and deliver:

- Compressor/unit for the natural gas grid injection
- A complete CNG-filling station, or just parts of it: CNG-compressor, gas storage for CNG, fuel dispensing pump, payment terminal, instrumentation & control and mutual setting of these components and of our biomethane plant (turn-key solution).
- LNG-unit, station
- Biogas/biomethane flare

4.2 Delivery of the client

- Earth & excavation works
- Concrete foundation in accordance with the requirements of Brimex
- Manpower for the finalisation at site and lifting mechanisms
- All pipes for inlet/outlet of necessary process media
- Power and data supply into the plant
- All necessary permits and authorization & approval procedures
- Calibration gases
- Filling for the odorant station unit

5. Delivery time:

6-9 months exports after our purchase order confirmation of the clients binding order and receipt of the technical specification which enables us exact construction of our plant plus after we received the down payment at the account of our company.

6. Warranty:

24 months after the commissioning but 27 months after the delivery at the latest.

7. Payment conditions:

40% down payment when the purchase order is placed

25% ten weeks after our order confirmation

25% half of the delivery time

5% at the announcement that the goods are ready to deliver (receiving the payment before delivery)

5% final payment after the testing operation is finished (but 3 months after delivery at the latest)

Maturity of the payment in 14 days.

Our bank connection:

C: UNCRSKBX (UniCredit Bank), Account No.: IBAN: SK9311110000001326930018

8. Retention of title

We reserve the right to retain title of the goods we deliver and services rendered until payment in full of all claims. In the event of attachment or other use of the retained goods on the part of third parties, the customer is obligated to inform of this retention of title and to notify the contractor. The assertion of this retention of title and the garnishment of the delivered item on the part of the contractor does not apply as a termination of contract, unless stipulated. In the event of processing, integration or combination with other goods that are not our property on the part of the customer, the customer hereby transfers the proprietary rights to the new item to us to the value of the invoice amount of the goods subject to retention of title. As required, the customer is obliged to sign all documents and approve all acts required to validly register the right to retention of title and other security rights in name. Costs incurred through a violation of this right to retention shall be at the unrestricted expense of the customer. Place of performance and legal jurisdiction for all disputes is the jurisdiction competent for the contractor. In the event that parts of these provisions should become invalid this shall not prejudice the validity of the remaining provisions of this contract. Such:

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.

Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx



invalid or unenforceable provision shall be substituted by a valid provision reflecting the closest the economic reasoning of the invalid or unenforceable provision.

BriMex Energy

Camino a la merced, 9000 CP 47515 Localidad Cieneguilla Lagos de Moreno, Jalisco Mexico.
Tel. (33)10.3.1.03.09 Cel. (33)39.54.46.69 Mail. contacto@brimexenergy.com.mx