



# FLOW MEASUREMENT AND API MDETERMINATION OF CRUDE OIL



## Oil & Gas / Midstream

„The reliability that the FLUXUS® H721 equipment gives to the process of blending and delivering the final product to the crude oil distribution system allows us to focus on what we really need, which is the correct preparation of the blends of the different diets in our refineries.”

*Eng. Adolfo Morales López,  
Level C Specialist Technician,  
Pemex Logística.*



## Measuring Task

**Non-intrusive measurement of volume flow and determination of the API gravity of various crude oils received, blended and exported at the Palomas Crude Oil Commercialization Center (C.C.C. Palomas)**

Mexico is one of the largest oil producers in the world (1.9 million barrels produced daily in 2021), and the fourth-largest in the Americas after the United States, Canada, and Brazil. In 2021, Mexico ranked 12th globally in crude oil production, 21st in crude oil reserves, 16th in refined capacity, and 5th in logistics infrastructure. Oil is a crucial component of Mexico's economy. Earnings from this industry accounted for around 16 percent of total government revenues in 2021 according to Pemex and the Secretariat of Treasure and Public Credit.

Crude oil produced offshore is transported onshore and processed there for further transport and distribution. About 50% of the national crude oil production is treated at Palomas Crude Oil Commercialization Center (Centro Comercializador de Crudo Palomas – C.C.C. Palomas), operated by Pemex Logística. C.C.C. Palomas is a strategic facility classified as triple “A” (according to the order of importance by Pemex). Any affectation or interruption of its normal operation process represents a direct and immediate destabilizing risk for the security of the Nation.

The purpose of C.C.C. Palomas is to blend, measure, distribute and market the Maya, Isthmus and Olmeca crude received from the producing areas of the Southern and Marine Regions. The API grade of the received crudes ranges from 22 (Maya) to 38 (Olmeca). C.C.C. Palomas has a crude storage center, as well as 12 blending lines, 3 dispatch lines and their respective transfer and custody units. Depending on the type of crude oil required by the respective refineries, the blending is regulated with automated valves, through a digital Distributed Control System. The flows are directed to the blending heads in order to obtain the quantity and quality of crude oil demanded by each center; the volumes of crude fluctuate between minimum and maximum values depending on the daily distribution assigned to C.C.C. Palomas.

The plant is equipped with numerous devices for measuring the relevant parameters, i.e., flow, pressure, temperature, density or API gravity. Furthermore, water and solids contents are determined as well as the salt and Sulphur content. A wide variety of measuring methods are used for flow measurement: positive displacement meters, orifice plates, Coriolis mass flow meters as well as wetted and clamp-on ultrasonic systems.

Turbine meters are installed in the blending units. These mechanical measuring devices are subject to heavy wear due to direct contact with the medium and cause enormous maintenance effort, which moreover requires at least partial plant shutdowns and operational downtimes. Therefore, the plant engineers were looking for a superior alternative and turned to Flexim's local representative, Gerardo Cervantes of CICSA.

## Solution



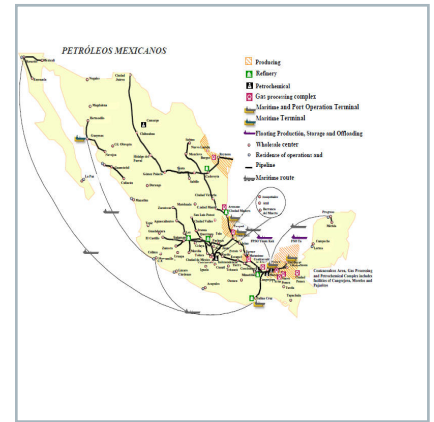
When it comes to retrofitting flow measuring points on existing piping systems, Flexim's clamp-on ultrasonic technology has long been the first choice. The oil and gas industry particularly appreciates the advantages of flow measurement from

the outside of the pipeline. Flow measurement from the outside means measuring from the safe side, without any risk of leakage, without wear caused by the medium flowing inside and without any impairment of normal plant operation. This results in another significant advantage of non-intrusive measurement technology: It can be thoroughly tested for its suitability for the measuring task on site before any decision to purchase is made.

Gerardo Cervantes had to reckon with some skepticism on the part of the plant staff, who had had bad experiences with clamp-on technology from other manufacturers. But Gerardo Cervantes did not come alone, he had brought experienced company:

Fernando Sosa, Flexim's Regional Sales Manager for Mexico. Together, they demonstrated with test measurements with their portable ultrasonic system that Flexim's technology is ideally suited for the job.

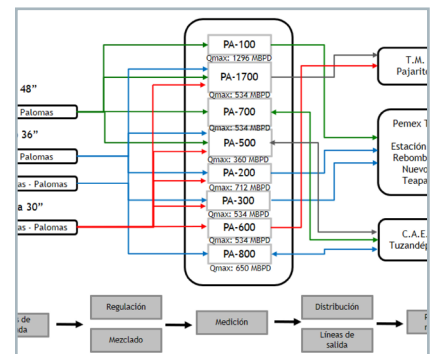
The plant engineers became even more alert when they learned that Flexim's non-intrusive ultrasonic technology can do more than just measure the volume flow rate. This is because they actually need not only the value



Infrastructure of Pemex  
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Aerial view of the Centro Comercializador de Crudo Palomas (C.C.C. Palomas), located near Coatzacoalcos in the State of Veracruz, Mexico.  
© Google Maps



Operation process of C.C.C. Palomas.  
© Pemex

for the volumetric flow as measured by the turbine meter, but also the mass flow in order to be able to draw up a correct mass balance. With its FLUXUS® H series, Flexim has developed an ultrasonic flow measurement system specifically for the needs of the hydrocarbon industry. It combines highly precise non-intrusive measurement of volume flow and sound speed with sophisticated calculation features. Exactly the same arrangement of clamp-on ultrasonic transducers mounted onto the outside of a pipe which is required for flow measurement allows the meter to also determine the acoustic velocity in the medium. This depends on the density – and therefore also on the temperature – of the medium and is a substance-specific quantity. The transmitter's internal HPI computer calculates API gravity, operational density, density at base conditions and kinematic viscosity. Temperature and pressure compensation according to industry standards such as ASTM1250, GPA TP25 and D4311 allows for precise mass flow (respectively standard volume flow) measurement of liquid hydrocarbons.

Impressed by the test measurements, C.C.C. Palomas decided to initially equip three lines in the mixing unit with stationary FLUXUS® H721 clamp-on ultrasonic systems. These not only completely replace the defective turbine meters, but also simultaneously provide the API value of the medium currently flowing in the pipe.

This ensures that the blending unit works properly and that the required quality is maintained at all times. In the near future, 12 more lines are to be retrofitted accordingly.

Eng. Adolfo Morales López, who is responsible for the smooth operation of the facility, underlined the excellent cooperation between the CCC Palomas team and Flexim and CICSA:

“We are highly satisfied with the decision to acquire and install Flexim's clamp-on equipment, not only for its quality, efficiency and performance, but also for the technical support of the representative and the brand in the area.”



*Eng. Fernando Sosa, Flexim's Regional Sales Manager Mexico, carrying out test measurements on a DN900 crude oil pipe.*



*Measuring point with the ultrasonic transducers mounted in Permalok rails on the outside of a DN300 crude oil pipe. Two measuring channels with two pairs of ultrasonic transducers allow for effective compensation of the effects of disturbed flow profiles.*



*The stainless-steel version of the FLUXUS® H721 ultrasonic HPI measuring system is used as transmitter.*



## Advantages

- Simple replacement of the obsolete turbine meters without opening the pipe and without interrupting operation
- Precise and reliable flow measurement from the outside of the pipe
- No wear and tear, therefore virtually maintenance-free
- Simultaneous output of the API gravity ensures continuous quality assurance and allows the drawing of a mass balance
- Two measuring channels for effective compensation of disturbed flow profiles
- Excellent collaboration between plant engineers and Flexim's local sales and support team

## Measuring Points and Instrumentation

<b>Pipes</b>	12"
<b>Media</b>	Various crude oil mixtures
<b>Temperature</b>	Ambient
<b>Pressure</b>	195 psi
<b>Measuring Device</b>	3 stationary ultrasonic FLUXUS® H721 HPI measuring systems (dual-channel version), stainless steel housing
	6 pairs of ultrasonic transducers type shear wave long cable size K, installed in Permalok mounting rail

## Customer

### Pemex Logística, Centro Comercializador de Crudo Palomas, Veracruz, Mexico

Petróleos Mexicanos (Pemex) is a state-owned production company of Mexico. Its objective is to maximise the value of oil revenues for the benefit of all Mexicans. Through its Subsidiary Productive Companies (EPS), Pemex Subsidiaries (EPS), Pemex carries out activities of exploration and extraction of hydrocarbons, refining and gas processing, the production of petrochemicals and other derivatives, and the transport and storage of hydrocarbons.

The Centro Comercializador de Crudo Palomas (C.C.C. Palomas) is Mexico's largest facility for measuring, blending and marketing crude oil. About 50% of the national crude oil production is processed here.



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