Kingdom of Saudi Arabia

SAUDI ARAMCO INTRODUCES NEW CONCRETE TECHNOLOGIES TO THE MASTER GAS SYSTEM PIPELINE PROJECT TO ADDRESS CONCRETE SUPPLY AND QUALITY ISSUES

- Remote concrete production
- Speciality concrete for time sensitive projects
- Unprecedented quality through technology

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Introduction

Saudi Aramco Master Gas System pipeline project

Saudi Aramco's Pipelines Projects Department (PPD) is currently executing the construction of a Master Gas System (MGS) pipeline mega-project along the East/West Pipeline corridor in Saudi Arabia.

The project consists of a 56-inch diameter pipeline that will transfer conventional gas from the eastern to the central and western areas of Saudi Arabia, to be used mainly in power generation. The project requires the use of massive amounts of concrete in remote areas for valve stations, pump station foundations, and pipeline anchor blocks.

The current model of concrete delivery

The current model of concrete delivery in the Middle East is the fixed location batch plant. As the name suggests, concrete is produced in batches in these plants and carried to the construction site in barrel trucks (transit mixers).

The concrete, once batched, has a finite life – typically somewhere in the 60-90-minute range – before it is unusable. Therefore, each batch plant can serve an area of up to 90 minutes travel time from the facility, and in the summer months this can be significantly less because of environmental considerations: heat is the enemy of good concrete and the process of mixing cement, sand and aggregate with water initiates an exothermic (heat generating) chemical reaction.

Concrete batch plants offer restricted geographical coverage by their very nature, they cover approximately 10% of the Kingdom of Saudi Arabia, meaning remote locations and projects outside the main conurbations have enormous problems in accessing quality concrete at affordable prices.

In general, batch plants offer a limited range of concrete types and do not typically offer specialty concretes such as the rapid hardening hydraulic cement concretes or natural pozzolan mixes which offer a range of benefits over normal Portland cement concrete (PCC): typically, these include faster setting times, impermeable to water, very low shrinkage, high strength and sulphate and chemical resistance.

Volucon – Volumetric Concrete (VC)

Volucon was established to specifically address many of the issues faced by companies and their contractors, such as Saudi Aramco, in accessing quality concrete in remote areas or who have special requirements in terms of the design mix required.

VC can aid in the delivery of the specified concrete design mix for any project and have it produced fresh on site when it is required, regardless of location on land, rail or sea and/or heavy transport curfews.

Traditional curing time for concrete can be reduced to hours not weeks, as is currently the case with traditional Portland cement concrete (PCC), allowing project times to be compressed saving time and money on strategically important projects.

By using Volucon's unique delivery model of volumetric mixers combined with ASTM, ACI, B.S. and AASHTO compliant specialty concrete, Volucon can offer contractors exactly this solution today, and more besides.

Volucon gives contractors the freedom to build what they want, where they want it, when they want it: shattering the construction paradigm that has constrained operations for too long. The key to unlocking this added value is the volumetric-measuring and continuous-mixing concrete production mixer (VMCM).

A mobile plant, the mixer can be located onsite quickly to make fresh concrete to any design specification to exacting international quality standards.

Figure 1: Generic schematic of chassis cab mounted volumetric-measuring and continuous mixing concrete unit. Each VC unit can produce up to 1,000 m³ of fresh concrete per 24-hour period.

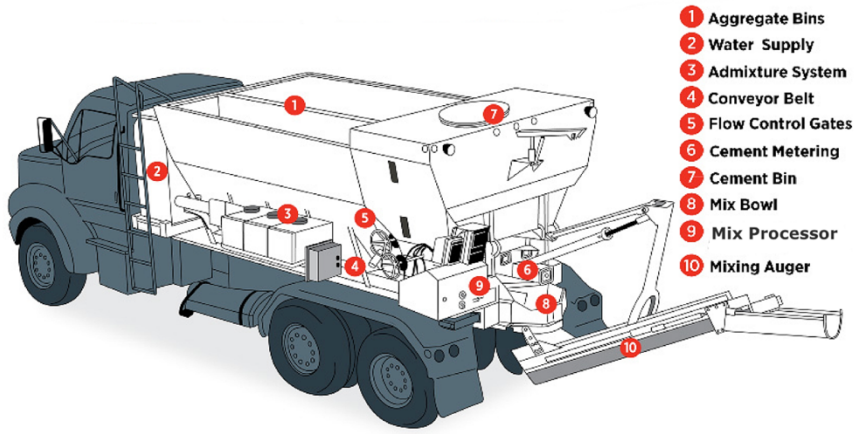

Figure 2: Volucon chassis mounted volumetric-measuring and continuous-mixing concrete production mixer (VMCM)

Saudi Aramco Pipeline Projects Department opts for new concrete technology (Volumetric Concrete) in the MGS Pipeline Project

Downstream Project Management (DPM) and PPD management, had recently challenged the project team to raise the bar in exploring and implementing new cost saving and innovative technologies for all ongoing and upcoming projects. In this regard, PPD management said, “Conventional execution of pipeline projects is part of the past, every stone should be turned to discover and utilize new technologies to optimize pipeline project executions.”

With the introduction of Volumetric Concrete and other future technologies, PPD is expecting to reduce construction cost and environmental impact on all future projects.

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new concrete technologies introduced to Master Gas System pipeline project

by Mahmoud A. Younis

The Pipelines Projects Department (PPD) is currently executing the construction of a Master Gas System (MGS) pipeline mega-project along the East/West Pipeline corridor.

The project consists of a 56-inch diameter pipeline that will transfer conventional gas from the eastern to the central and western areas of Saudi Arabia, to be used mainly in power generation. The project requires the use of massive amounts of concrete in remote areas for valve stations, pump station foundations, and pipeline anchor blocks.

volumetric mobile batch plant

The nonavailability of close concrete fixed batch plants to the remote site locations, and the Saudi Aramco Standards restrictions on the conventional concrete method of mixing and transporting concrete to remote job locations, posed a problem for the MGS Project (Phase 2) — especially in the Western Region between Pump Stations 7 and 11.

The Saudi Aramco Project Management team, in collaboration with the Consulting Services Department (CSD), proceeded with exploring the use of a mobile concrete batch plant, that it has pioneered to bring this new technology into the Kingdom.

An arrangement was coordinated with a mobile batch plant supplier, as well as a contractor company, to use this new concrete batching method on the project.

'green' concrete

Additionally, in collaboration with a local batch plant, the use of "green" concrete on a Saudi Aramco MGS project was introduced for the first time. This concrete constitutes the use of crete, which is a natural concrete additive to replace the conventional fly-ash or micro-silica additives. The crete proved to be effective and provided multiple benefits such as temperature control, workability, and strength.

Several benefits are expected from the use of these two new concrete technologies:

- Continuous availability of fresh concrete at the site
- Ease of switching between different concrete mix designs
- Ease of moving to different locations in remote areas
- Eliminating concrete waste and environmental impact
- Less cementous material required for mixes, which result in a reduction of carbon dioxide emissions to the atmosphere
- Cost savings due to less cement required Kingdomwide
- Cost savings achieved due to the difference between mobile and fixed batch plants for remote areas.

Downstream Project Management and PPD management have recently challenged the project team to raise the bar for exploring and implementing new cost saving and innovative technologies on all ongoing and upcoming projects.

With the introduction of concrete and other future technologies, PPD is expecting to reduce construction costs and the environmental impact on all future projects.

This mobile concrete batch plant, which the Consulting Services Department helped bring into the Kingdom, has helped significantly at remote site locations on the Master Gas Syste Project (Phase 2).

Master Gas System benefits from 'green' concrete

Meeting the demands of a significant Master Gas System pipeline project, Project Management joins forces with the Consulting Services Department to help bring much-needed concrete to remote construction projects.

Figure 3: Excerpt from Saudi Aramco's publication, The Arabian Sun. Published April 25, 2018.

Advantages of Volumetric Concrete

- Remote areas availability of high quality concrete, continuous availability at sites, even in tough topographies with a zero-mobilization time
- Volumetric mixers can be mounted on self-drive chassis, trailer units, ocean going barges or even railway carriages, offering a wide range of delivery solutions
- Significant cost savings compared to conventional concreting methods
- Approved by all major worldwide specifications and standards bodies
- Recommended by major companies in Saudi Arabia such as Saudi Aramco

High productivity and accuracy with zero wastages (eco-friendly)

- Ease of switching between different concrete mix designs on the spot
- Savings and less usage of raw materials (such as concrete chemical admixtures)
- Concrete is mixed/produced and poured fresh at the point of demand (onsite) which reduces the travel time and provides higher quality control, strength and confidence
- Able to produce specialty concrete such as URH Concrete (Ultra Rapid Hardening Concrete) which complies with American Standards ASTM C1600, Rapid Hardening Cements can be used only with volumetric mixers because this type of concrete starts setting within minutes and reaches its designed/structural strength in less than 90 minutes compared to 28 days for traditional concrete methods (significantly reducing projects' construction duration)
- All VC units are optimized for the harsh MENA and GCC climate ("Gulf Spec") and can be manufactured/designed/tailored/tuned based to each project's requirements
- Road and airport runway pavements, can be repaired and returned to service quickly using URH Concrete, avoiding costly delays and interruptions to service
- VC mixers can produce other specialty concretes in any strength/slump possible such as green and eco-friendly concrete, natural pozzolan concrete, fibre concrete, marine & subsea concrete, polymer concrete, coloured & fluorescent concrete, chemical & sulphate resistant concrete, earthquake resistant concrete, green concrete, sustainable concretes (e.g. GGBFS & fly-ash concrete0, shotcrete and gunite etc.

Challenges in MGS pipeline project & Volucon's solution

The non-availability of concrete fixed batch plants in proximity to the project, particularly the remote site locations, and Saudi Aramco Standards restrictions around conventional concrete method of mixing and transporting concrete to remote job locations, posed a huge challenge for the MGS Project (Phase 2), particularly in the Western Region, between Pump Stations 7 and 11.

The project was challenging in part due to its very nature and extended length over some 422km, as well as the many valve and pump stations scattered in remote locations that required to be poured with limited site access across open desert.

The schedule of pouring itself presented an additional challenge as the job sites were not linear, rather they were distributed across the length of the project.

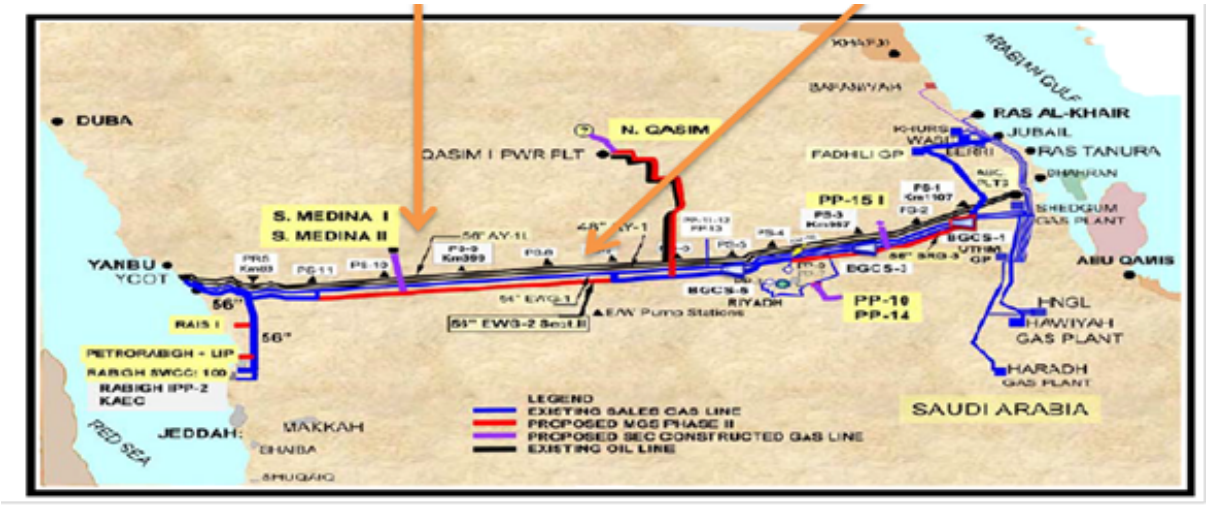
Traditional batch plants could not supply specification grade concrete because of their location at distance to the project. Temporary batching plants, in such scenarios are a theoretical solution, but the associated costs are huge in terms of mobilization/demobilization/relocation etc. (including preparation of foundations and civil works in addition to having to move large amounts of equipment and heavy machinery required, all of which are huge limitations, aside from being extremely costly and time consuming).

The project study showed that it would require a large number of batching plants to be available simultaneously to cover the project's length and concrete requirements. This was deemed impractical, entirely outside the project budget, and unsuitable due to time constraints and wastage concerns.

The Saudi Aramco Project Management team (PMT) in collaboration with the Consulting Services Department (CSD), proceeded to explore the use of mobile volumetric concrete mixers (VMCM).

In collaboration with Volucon Aramco decided to utilize this new technology in the Kingdom for the project. This decision proved both a cost-effective and timely solution, overcoming smoothly all the challenges and obstacles faced thus far in the project.

Figure 4: Saudi Aramco Master Gas System pipeline project map



Saudi Aramco (CSD) testimony

"…Aramco CSD strongly support the use of mobile volumetric batching in Saudi Arabian remote areas where it is hard to deliver fresh concrete within Saudi Aramco specified time with specification conformance. This will save the company and country great amounts of money wasted on rejected concrete or requirements to build batch plants in remote areas that is going to be used only during construction. This method also assures quality concrete to be delivered fresh on site."

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Quality, approvals and certification

Volucon-produced volumetrically-measured and continuously-produced concrete complies with all internationally recognised standards and can be specified to extremely fine tolerances (+/- 1% materials).

	CalTrans – Californian Dept. of Transportation Approved for use in earthquake sensitive locations by Caltrans
	TXDOT – Texas Department of Transportation Approved under ASTM standards C685/C685M – "Specification for Concrete Made by Volumetric Batching and Continuous Mixing."
	ASTM International – American Society for Testing and Materials ASTM C685 – "Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing."
	ACI – American Concrete Institute Guide 304.6R-09 – "Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment."
	AASHTO – American Association of State and Highway Transportation Officials AASHTO M 241M/M 241-09 – "Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing (ASTM Designation: C 685/C 685M-07)."

Volucon's mission

Volucon's mission is to provide efficient, cost-effective access to high quality concrete for our customers, regardless of their location or requirements. This gives project proponents and contractors the freedom to build and shifts the construction paradigm.

The Volucon business model

Volucon is a global business that has been carefully planned, strategically and operationally, by a professional management team drawn from across the globe.

Saudi Aramco are Volucon's main backers and were Volucon's seed investor in the business established in the Kingdom.

Volucon holds exclusivity agreements / manufacturing and sales rights with the leading VC manufacturers as well as maintaining a considerable depth of in-house industry knowledge. Volucon has co-developed the units to ensure they are suitable for the harsh Gulf climate.

Volucon holds exclusive supply agreements for a range of rapid hardening cements (ASTM C1600/C1600M-11).

Volucon
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