aroforming methaforming

Make gasoline or BTX at 1/3 the cost

Reduce CO_2 by 0.4 t/t

Introduction to Methaforming/Aroforming

GAZPROM NEFT

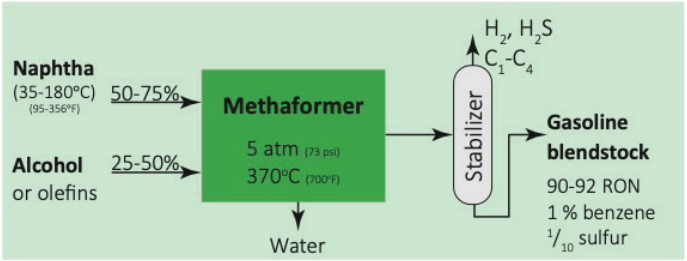
ngt new gas technologies

aroforming

Aro- and Methaforming[1] technologies produce gasoline out of naphtha and alcohol at **1/3 of the cost** of traditional processing technologies at comparable yields.

By using ethylene (e.g. from FCC dry gas) or ethanol as the cofeed, refiners get the added benefit of **reducing CO_2 emissions by 300-400 kg per ton of naphtha**.

One Step Conversion into Gasoline*



- No precious metals in the catalyst
- Capital and operating costs like a hydrotreater
- Works well at small scale, too

* BTX can be made similarly; for simplicity, only gasoline mode shown here.

In the Methaforming process, naphtha and alcohol (methanol, ethanol, etc.) and/or FCC dry gas go through a unit similar to a hydrotreater at modest pressure and temperature.

The product is like reformate: a gasoline blendstock with relatively low sulfur and 1% benzene. Just like a reformer, the methaformer produces some light ends, and hydrogen is released. By desulfurizing, there is H_2S in the overhead.

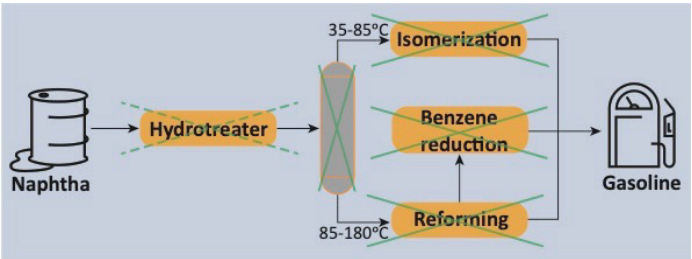
The Methaforming **process flow resembles a hydrotreater**, in which:

- Ethylene and/or an alcohol is used instead of hydrogen,
- There is no recycle compressor, and
- The combination of exo- and endothermic reactions in the same vessel reduces the need for external heat and is responsible for a part of the emission benefits.

The **yields of a Methaformer are similar to a semi-regenerative reformer with an isomerization unit**, except:

- Most benzene is converted to toluene,
- Part of the alcohol becomes water.

Methaforming is Simpler and Cheaper



Catalytic reforming and isomerization

- Most common technology
- Feed hydrotreater required
- Several process units

methaforming

- Reduce emissions by half
- Reduce costs to 1/3
- Simple single process unit

The capital and operating cost advantage of Methaforming is because it is a **one step process that replaces four units** and runs on inexpensive zeolite catalyst that does not contain precious metals. This is why **the costs for the entire Methaformer are comparable to a single hydrotreater**.

Unlike a reformer, the Methaformer charges almost any naphtha and reduces its sulfur content by 90%. It replaces the reformer and because most of the benzene is alkylated to toluene in Methaforming, it avoids the need for benzene-reducing equipment. Methaforming effectively processes light naphtha, thereby eliminating the need for an isomerization unit.

1 When a light olefin is used as a cofeed we call the process Aroforming. For simplicity, we use the term "Methaforming" as umbrella for both technologies.

Below is a practical example of a small Methaformer recently designed for a client in South-East Asia.

The client's objective is to process inexpensive full range naphtha with a limited amount of methanol into RON 95 gasoline; local standards allow blending.

21k tpa Methaformer: $3.2m annual margin on $3m investment

Designed in 2021 for a client in S-E Asia. CapEx $ 3 million.

		Tons per year
Feed and Blendstock	**Full Range Naphtha**	**21 000**
	Methanol	3 000
	Other blendstock	150
Utilities	Natural gas	2 900
	Electric power	2 500 MW-h
Products	**Gasoline 95** (after blending)	**16 100**
	LPG	5 500

- **Operating Margin: $ 3.2 million / year**
- **Payback period: 11 months.**

With a **payback period under a year**, this Methaformer is an excellent investment.

A conventional processing train (hydrotreater – reformer – isomerization – benzene removal) would be prohibitively expensive and even may not work at this small scale.

Larger refiners operating FCC units and/or other processing equipment that generates light olefins, should pay attention to Aroforming – a variation of our technology, developed jointly with Gazpromneft.

With Aroforming, a refiner can **capture the value of the FCC dry gas twice: by upgrading it to gasoline blendstock, and by reducing CO_2 emissions**.

The prices in the table below are US spot prices for October 2021. Carbon emissions are priced for US and Canadian West Coast.

Aroforming: upgrade naphtha and monetize FCC dry gas for a $330/ton margin

		kg	USD
Feed and Blendstock	**Naphtha**	**1 000**	(763)
	Olefins from FCC dry gas	350	(93)
Utilities	Fuel gas	51	(14)
	Electric power	110 kW-h	(7)
Products	**RBOB Regular**	**1 070**	943
	LPG	280	199
	CO2 reduction	**363**	65
Operating Margin			**$ 330 /ton of naphtha feed**

Aroforming and Methaforming can be implemented either in a purpose-built facility, or by **converting an existing hydrotreater or a reformer** into an Aroformer or a Methaformer at a modest incremental investment.

aroforming methaforming

We are in active discussions with several refiners, most of which we can not disclose due to confidentiality obligations.

A major Russian refiner, Gazpromneft, our collaborator, has included two Aroformers into their long-range plan based on extensive pilot plant testing.

Where to Expect Future Aro- and Methaformers

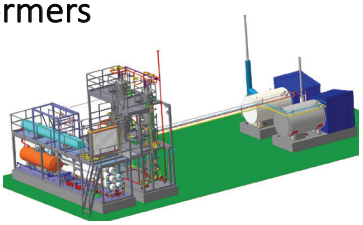
- **Major Russian refiner, GazpromNEFT**
  - Two Aroformers planned (20k tpa, 480k tpa)
  - Conducted 160 pilot plant tests
  - Feeds: raffinate, benzene precursor naphtha with FCC dry gas.
- **Refiner in Uzbekistan**: 20 k tpa Methaformer
  - Conducted 3 sets of pilot plant tests
  - Feed: light naphtha, full range naphtha.
- **Several refiners in CIS, Africa & Middle East, Asia:** Convert low value naphtha into finished gasoline.

The larger of the units (480k tpa) will process **aromatics extraction raffinate, and a benzene precursor stream that is now bypassed around reforming**.

To check if the Methaforming technology can **benefit your refinery**, please let us have the qualities of your naphtha, and what you want to achieve. We will then forecast the yields and suggest how an Aroformer or a Methaformer can fit into the configuration of your refinery.

If your naphtha is unlike any of the 300+ that we have tested before, we can test it in one of our pilot plants to confirm, and you are welcome to witness the testing. After this, we will develop a process technology package that can be used either by your preferred EPC company or our fabrication partner.

Skid Mounted Methaformers Ready for Order



- Two sizes available:
  - 6 k tpa (150 BPD) for $1.2 mil (6 mo delivery)
  - 21 k tpa (530 BPD) for $2.7 million (15 mo delivery)
- Includes all inside battery limits (ISBL)
- OSBL by owner – much may already exist
  - feed and product tankage, MeOH/EtOH receiving
  - hydrogen rich gas H_2S removal, LPG sweetening
  - utilities: fuel gas, electricity, wastewater treating.

Many potential customers are interested in quick delivery, low-cost skid mounted units. We have designed **two versions that can be built quickly**.

These can be delivered within 6 or 15 months, and include all of the equipment necessary inside the battery limits (ISBL).

Scan this code to access our website

Americas, W. Europe: Stephen Sims
S.Sims@ngt-synthesis.com
+1 (832) 640-5921

E. Europe, Middle Asia: Denis Pchelintsev
D.Pchelintsev@ngt-synthesis.com
+7 (903) 527-2200