Glycol Filtration

a new application in natural gas production plants

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TOPICS

- What is Glycol and how is it used ?
- Filtration Requirements for Glycols
- Filter Design Basis and Performance
- Process Flow Diagram
- Conclusion

What is Glycol and how is it used ?

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Besides Amine Glycol is the second chemical that is used in nearly every natural gas production plant in large quantities. Circulating in a closed loop Glycol is subject to degradation and accumulation of impurities.

Glycol storage tanks during shipment to STATOIL's new Liquid Natural Gas (LNG) Production Plant in Hammerfest, Norway.
The large storage tanks for Lean and Rich Glycol have holding capacities of 3'500 m3 each and weight around 400 tons.

What is Glycol and how is it used ?

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Glycol in the form of MEG or TEG (mono-ethylene-glycol, tri-ethylene-glycol) serves as an antifreeze agent.

Glycol is injected into the wellstream to prevent the formation of ice and blockages in the pipeline carrying raw gas to land.

STATOIL’s Liquid Natural Gas (LNG) Production Plant near Hammerfest, Norway during construction

What is Glycol and how is it used ?

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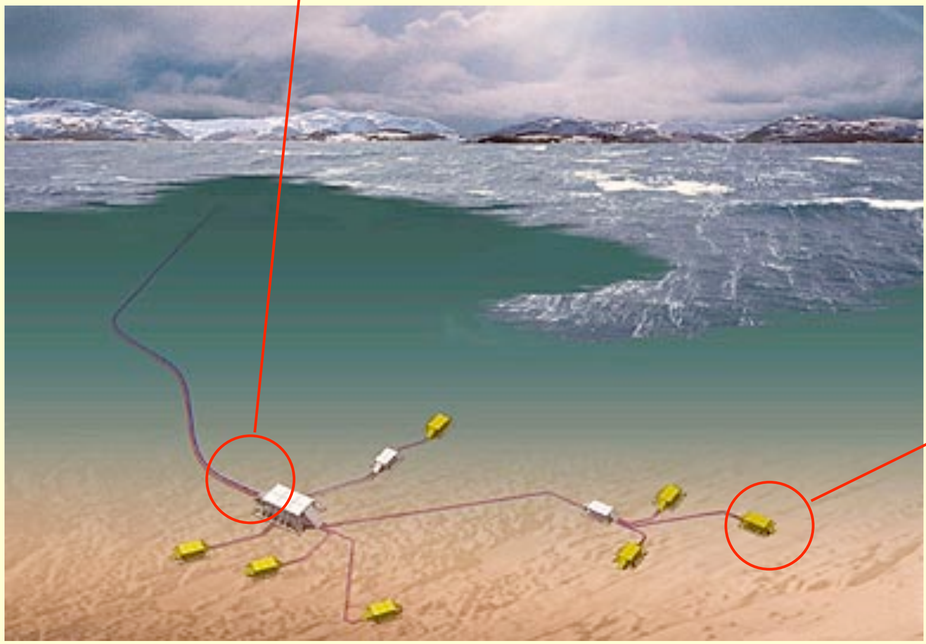
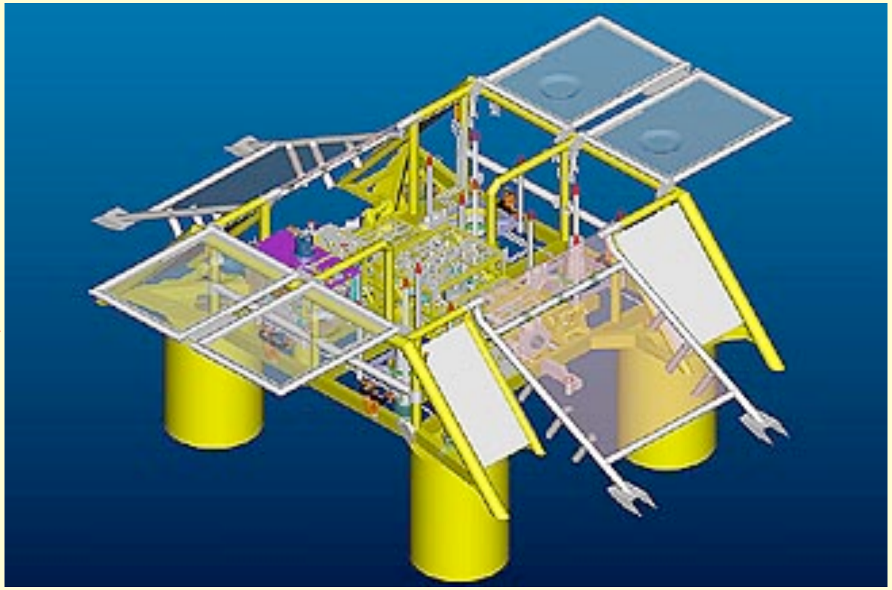
Subsea pipelines & manifolds

"Rich" glycol arriving on land - after separation of coarse solids (dirt, sand etc.), liquid hydrocarbon and the gas phase - contains fine solid impurities, dissolved HC, dissolved salts and approx. 40 - 50 % water.



Subsea wellheads, pipeline and gas distribution network



Subsea well platform

Filtration Requirement for Glycol

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Before "Lean" glycol can be send back offshore to the wellhead it must be regenerated in a multi-stage purification process.

While dissolved components are removed by adsorption / ion exchange and water is evaporated, fine solids must be filtered out as the first step.

Typical solids to be removed:

- **Carbonate Scale $CaCO_3$, $MgCO_3$**
- **Corrosion $FeCO_3$, FeS, Fe_3O_4**
- **Very small particle size 1-10 μm**
- **Total solids ~ 100-200 ppm**

Typical Design Values for the Filter System

Required solids recovery rate 99%

Feed Composition in wt%		
H2O	42.53	wt%
MEG	55.77	wt%
CO2	234	wt ppm
H2S	1	wt ppm
Hydrocarbons	109	wt ppm
Aromates	550	wt ppm
Phenol	625	wt ppm
Salt	0.62	wt%
NaOH	0.89	wt%
Dissolved Carb.Scale	188	wt ppm
Dissolved Corrosion	49	wt ppm
Carbonate Scale solid	76	wt ppm
Solid Corrosion	83	wt ppm

Flow rate	kg/h	15 322 x 1.5
Pressure	barg	7
Temperature	°C	30
Density	kg/m3	1051
Viscosity	cP	3.8

Filter Design Basis & Performance

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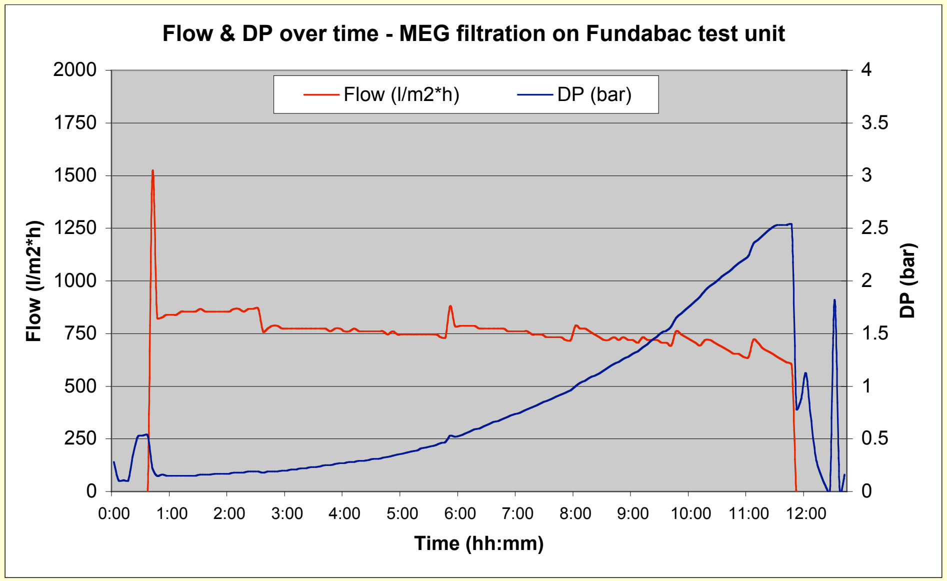
Extensive pilot tests at a site with a 2.7 m2 FUNDABAC® filter were very successful.

Filter aid as precoat + body feed was necessary to achieve the required filterability and filtrate quality.

DrM designed and quoted the full scale filtration unit - a dual filter skid with 2 x Fundabac R-62 m2.



Data from pilot test run

	Capacity Case		150% 22983 kg/hr	100% 15322 kg/hr	Remark
1	Continuous filtrate flow	m^3/hr	21.9 [1])	14.6	Note [2])
2	Continuous feed flow to filter	m^3/hr	44		Note [3])
3	Continuous overflow	m^3/hr	23.1	29.4	Note [3])
4	Expected duration of the filtration	hr	5	7.5	
5	Suspended solids in feed from Rich MEG storage tank	ppm	200		(design maximum)
6	Mass flow of suspended solids to filter	kg/hr	4.60	3.06	
7	Required differential pressure across filter towards end of filtration	bar	6.0		
8	Required inlet pressure to filter	barg	7.0		Note [4])
9	Suspended solids in treated Rich MEG	ppm	≤ 1 [1])		Note [5])
10	Filtration efficiency	%	≥ 99		Note [6])
11	Filter aid type for pre-coat		Celite® 545		
12	Filter aid dosage for pre-coat (kg per m^2 filter area)	kg/m^2	0.75 - 1.0		
13	Filter aid type for body-feed		Celite® 545		
14	Filter aid dosage for body-feed (kg per kg of suspended solids)	kg/kg	2		
15	Total filter aid consumption (kg per kg of removed solids)	kg/kg	5.0 [1])		
16	Filter aid content of body-feed slurry	% wt	10		
17	Volumetric flowrate for pre-coating	m^3/hr	90		
18	Diff. head recomm. for pre-coat pump	m	16		Note [7])
19	Volumetric flowrate for body-feed	l/hr	92	61	
20	Dryness of the discharged filter cake	% wt	≥ 55 [1])		

Design figures of full scale unit

Conclusion

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The proposed FUNDABAC® Filter provides significant advantages compared to alternative filtration solutions which were also considered:

- **Considerable savings on operational and waste disposal cost compared to cartridge filters traditionally used in Glycol systems.**
- **Improved filtration efficiency (70-80% —> 99%) compared to decanter centrifuges and savings on slurry disposal cost.**
- **Reduced Glycol losses.**