ELLYCRACK

ON-SITE HEAVY OIL UPGRADING TECHNOLOGY

Technology preview

Oslo, October 2011

Presentation of Ellycrack Technology

- Background
- Introduction to Technology and Innovations
- Status and Testing
- Business Case
- Summary of Key Benefits

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Background

Ellycrack AS

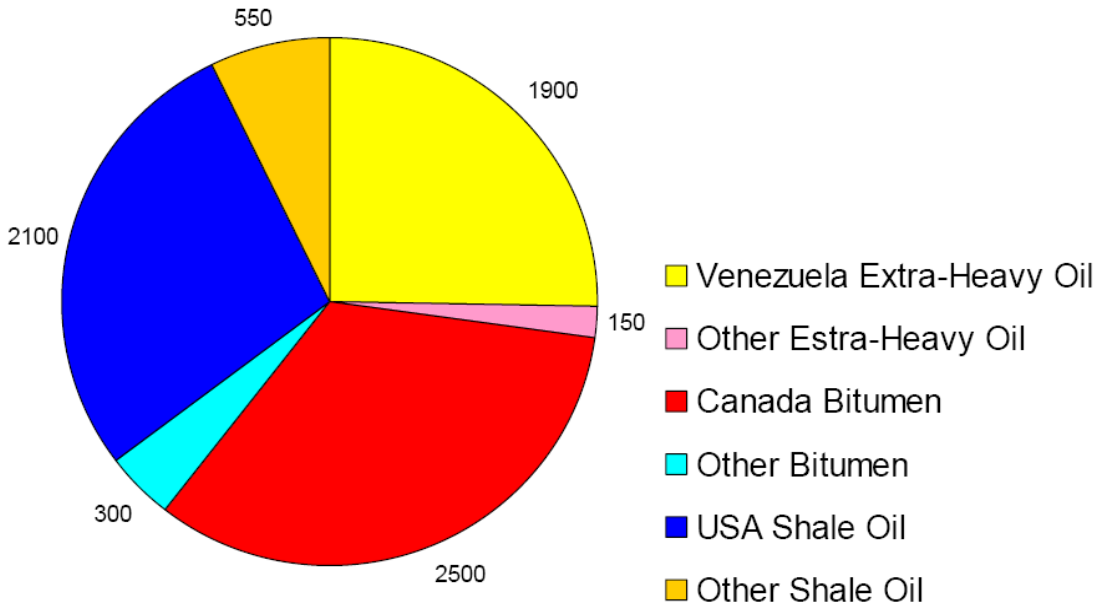
- Incorporated in Norway 2001
- Has about 100 shareholders
- About 7 million outstanding shares
- CEO, Engineer, Olav Ellingsen
- The company subcontract its other needs such as accounting, auditing, financial advisors and legal assistance from case to case.
- Board of Directors
  - Chairman, Master of Science Fritz T. Wegmann, Zurich
  - Member, lawyer Morten Borch, Oslo
  - Member, marketing investigator Bjarte S. Ellingsen, Oslo
  - Member, Geologist Ph.D Gemma Keaney
  - Member, engineer Olav Ellingsen, Oslo

R&D Partners/Subcontractors

- **Sintef Energy Research AS, Trondheim, Norway**
  - Professor Jens Hetland
  - Ph.D. Jørn Bakken
- **Nyhavna Mekaniske AS, Norway**
  - Engineer Sig Fuglestad
- **KGD Development AS, Norway**
  - CEO Engineer Roger Gale
  - Professor Finn Drangsholt
- **Bantrel, Edmonton, Canada**
  - Engineering
- **Universite de Technologie, Compiegne, France**
  - Président du Directoire Christian Deblois
  - Président Alain Strock

Heavy Oil Reserves

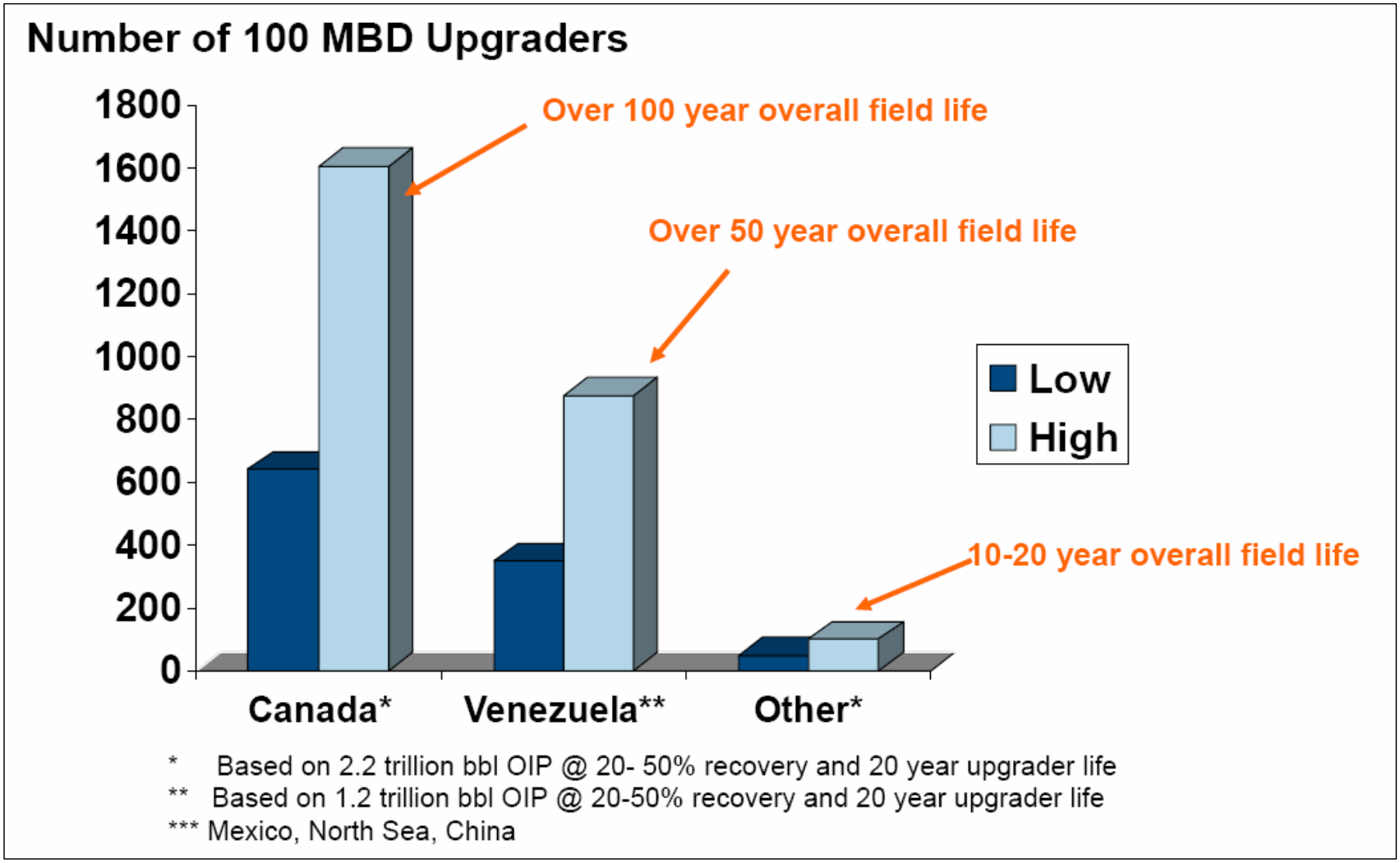
- **2/3 of the world's total oil reserves are heavy oil (*), rising**
- **86% of heavy oil reserves are located in Canada and Venezuela.**
- **In Canada, heavy oil is produced both from oil wells and from oil sands (bitumen).**



Distribution of the heavy oil reserves (in Billion barrels)

(*) Source: Wikipedia

Market For Heavy Oil Upgraders



Source: GE Energy Estimates

Problems Connected With Existing Technology

- Conventional heavy oil producers:
  - Need of light oil (diluents): Diluents need to be pumped down in the well to be blended under ground before it can be pumped to the surface
  - The blended oil must be upgraded in a cracker before it can be routed to a refinery
- SAGD (steam based) oil sands producers:
  - Need of light oil (diluents): The warm heavy oil from the well needs to be blended with diluents before it can be pumped to a cracker
  - The blended oil must be upgraded in a cracker before it can be routed to a refinery
- Conventional crackers require huge capital investments
- High output of CO2
- Environmental footprint

Heavy oil does not flow

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Introduction to Ellycrack´s technology

What is Viscositor?

- Ellycrack is a “dry” process for upgrading of heavy oil at the oil field

- Technical feasibility based on:
- Unique low temperature and low pressure thermo-kinetic process
- Process equipment known to the industry
- Small and big size plants built at about the same investment cost per flowing barrel
- Fitting existing infrastructure in the oil industry

- Ellycrack AS will develop, refine and commercialize this technology, which offers substantial economic and environmental benefits to clients engaged in production of heavy oil

The Benefits of the VISCOSITOR Technology

- **Low capital cost: "investments per barrel per day" at USD 10.000 which is about 1/5 compared with a conventional cracker**
- **Low energy consumption due to low process temperature**
- **Low operating cost: 3-5 USD per barrel**
- **Self supplied with energy: using the generated coke in the heavy oil as fuel**
- **Substantial reduction of CO_2 , sulfur and heavy metals**
- **No advanced catalysts**
- **Easy to scale up**
- **The plant can be located and upgrade the heavy oil on the oil field - therefore no need for diluents to be transported**
- **The oil can be routed directly to a refinery**
- **Increase the value of oil with 25-30 USD per barrel by upgrading heavy oil from 8 API to 29 API (*)**

(*) Source: The Canadian Association of Petroleum Producers (CAPP) - from a diagram showing historical price difference between Bitumen heavy oil and West Texas Intermediate, reduced by 5 USD as WTI premium

Ellycrack - How It Works
Simplified Flow Diagram

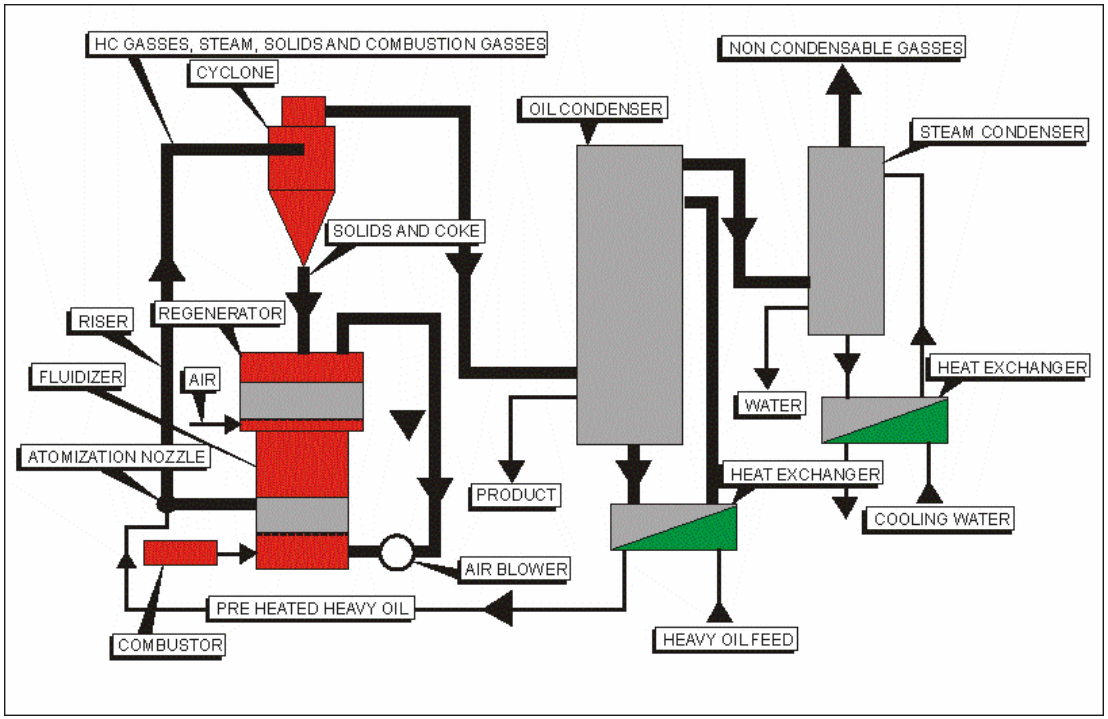
The basic process can be described in 4 key steps:

1. **From a reactor, hot fine divided particles (sand), heated by coke combustion are pneumatically conveyed into a “collision” riser by hot combustion gasses.**

2. **Pre-heated steam atomized heavy oil is injected into the riser and collide with the particles causing an instant evaporation and cracking.**

3. **In the cyclone the solids and generated coke are separated from the stream and routed to a regenerator and the oil gas and non condensable gasses are routed to a dual condensation system.**

4. **The generated coke is used to fuel the process where the regenerated solids used as a heat carrier are routed into the reactor and riser again in a loop.**



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Status and testing

Development To Date

- Test rig built at SINTEF Energy Research, Norway where the concept has been proven with following results:
  - Upgrading oil from 8 API to 29 API
  - 60% reduction of CO_2 emissions in in the upgrading process compared with existing upgraders
  - 50-60% reduction of sulphur in the oil
  - 90% reduction of heavy metals in the oil
  - Less than 0,3w% olefins generated
- One patent granted, one patent pending (granted in Russia and Australia) and three under preparation
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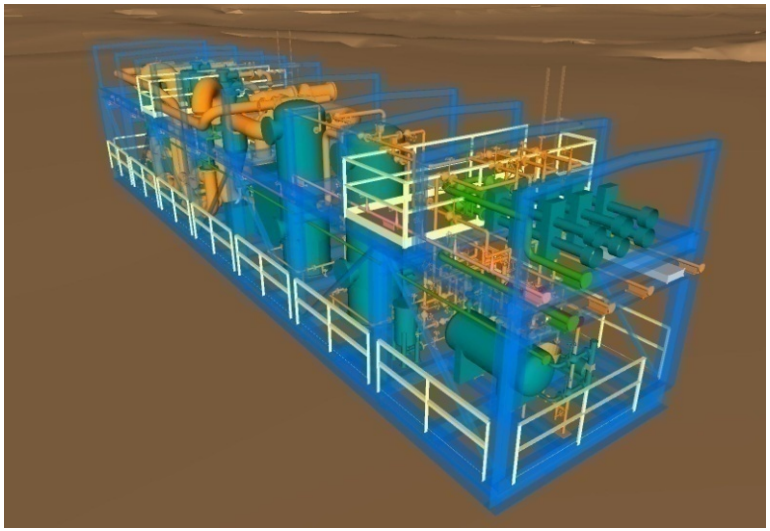
Test rig at Saskatchewan Research Council, Canada



GA of a 300 bpd plant designed by Bantrel, Edmonton

Characteristics

- Low temperature due to low partial oil pressure
- Self sustained with energy by coke combustion
- No advanced catalyst, fine grained minerals as heat carriers
- Acting forces:
  - Thermal forces from the heat carriers (sand) = mass of sand x specific heat of sand x temperature.
  - Mechanical shear forces – high speed impacts of heat carriers (force) $F = mdv/dT$, plastic and semi plastic impacts, (change of velocities) $mv_1 = mv_2$, $dv = v_1 - v_2$
  - Cavitations
  - High velocities of heat carrier, kinetic energy $E = mv^2/2$, converted/absorbed energy $dE = mdv^2/2$
  - Heat spots $t = dE/mc_s + t_p = dv^2/2c + t_p$
- Metal reduction by 90%
- Sulphur reduction by 50-60%%
- 5% ”hydrogenation”, but not yet fully understood

Testing Results

MATERIAL	INITIAL API	UPGRADED API	COMMENTS
Pit oil Venezuela PDVSA	6,2	22,5	Collected from a macro pit at San Tome
Crude Venezuela PDVSA	9,3	20	Undiluted crude from Melones
Blended oil from Venezuela, PDVSA	14,9	21,5	Diluted crude from Melones first test
Blended oil from Venezuela, PDVSA	14,9	29,3	Diluted crude from Melones second test
Crude from NORSK HYDRO	18	29,5	Grane Oil Field in the North Sea
Canadian crude SUNCOR	13,18	25,2	Loydminster

CO_2 Comparison

- **Existing upgraders**:

CO_2 emissions from gas consumption for upgrading (1):	**44 kg/bbl**
Production of coke as by-product (2):	**146 kg/bbl**
Total CO_2 generated:	**190 kg/bbl**

- **Ellycrack:**

CO_2 emissions from coke consumption for upgrading:	**16 kg/bbl**
CO_2 emissions from producing surplus electricity 63,9 kw/bbl (3):	**42 kg/bbl**
Total CO_2 generated:	**58 kg/bbl**

(1) Source: Canadian Association of Petroleum Producers (CAPP) . Based on average of 0,5-07 Mcf/bbl.

(2) Source: Handbook of alternative fuel technologies. Based on yield 25% w/w which is average both on Delayed coking and Fluid coking of oil 8-10 API (bitumen). The quality of this petroleum coke is poor. Therefore it is mainly deposited .

(3) Surplus electricity may be used for generating steam for SAGD-producers.

Results of Viscosities

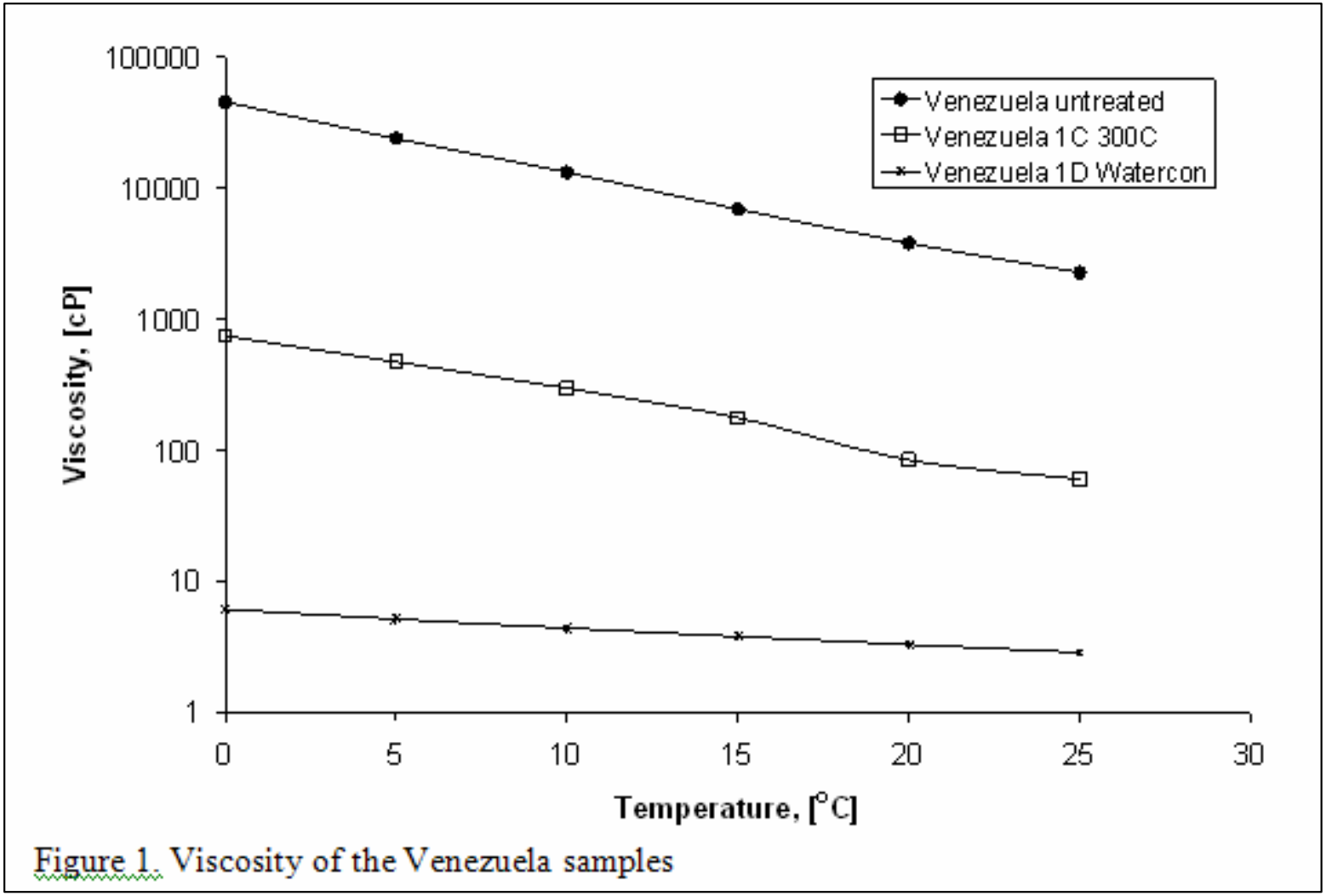


Figure 1. Viscosity of the Venezuela samples

Results of Grane oil (1)

Crude from the Grane Oil Field in the North Sea.

Client: Norsk Hydro

Test performed: 12.12.05

Table 1 and 2. Densities

Sample	Density [g/cm^3]
Grane crude	0.937
Grane hot condenser	0.894
Grane cold condenser	0.849

Results of Grane oil (2)

	Density	RD	API
Grane crude	0,94	0,940941	18,88138
Grane sample 1 hot condenser	0,899	0,8999	25,73971
Grane sample 1 cold condenser	0,844	0,844845	35,98637
Grane sample 2 hot condenser	0,906	0,906907	24,52483
Grane sample 2 cold condenser	0,855	0,855856	33,83158

Table 3. SARA analysis [wt%].

Sample	Saturates	Aromatics	Resins	Asphaltenes
Grane crude	40.8	42.1	14.5	2.65
Grane hot condenser	61.1	36.2	2.3	0.37
Grane cold condenser	66.2	33.1	0.6	0.03

Results of Grane oil (3)

Table 3. SARA analysis [wt%].

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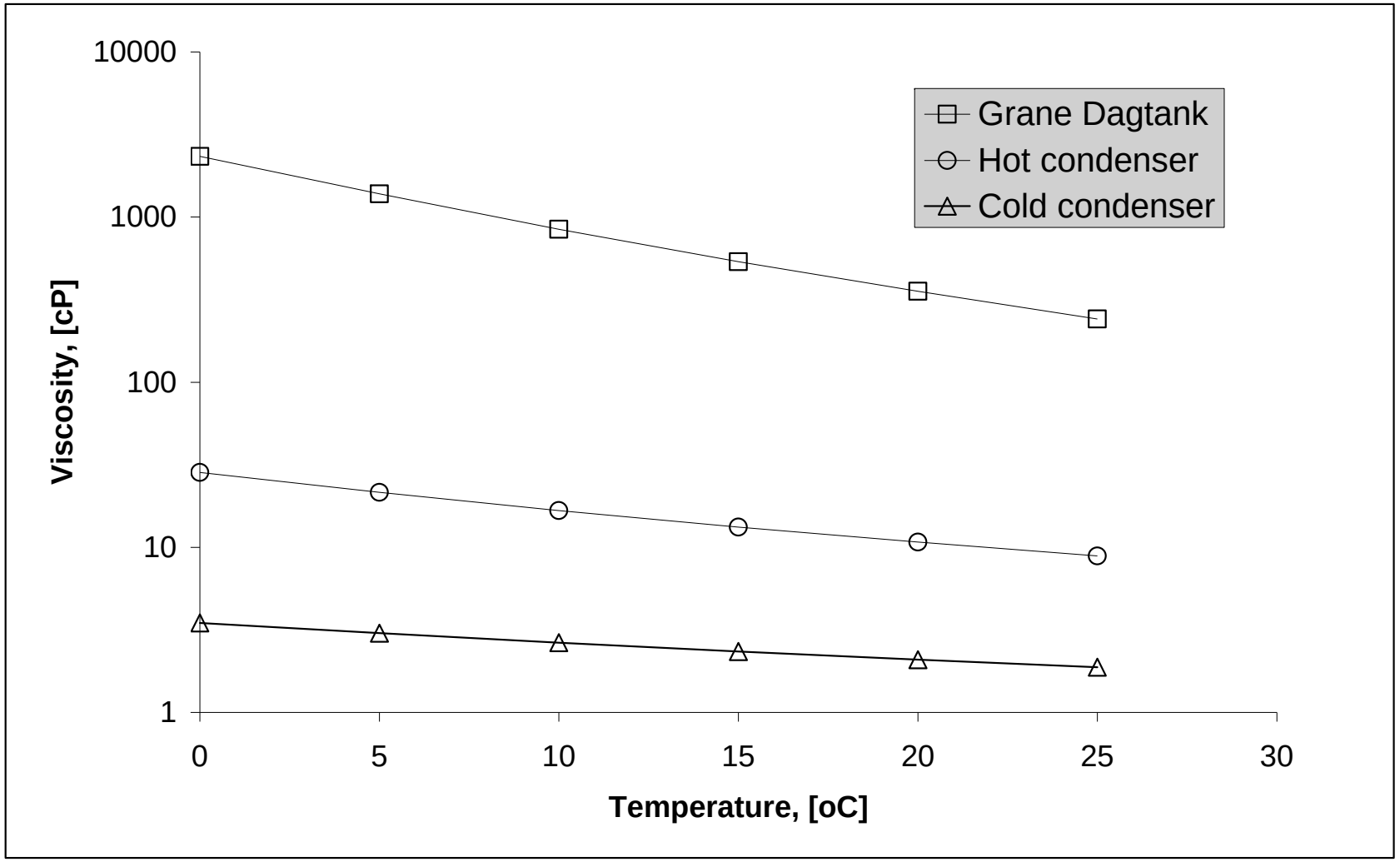
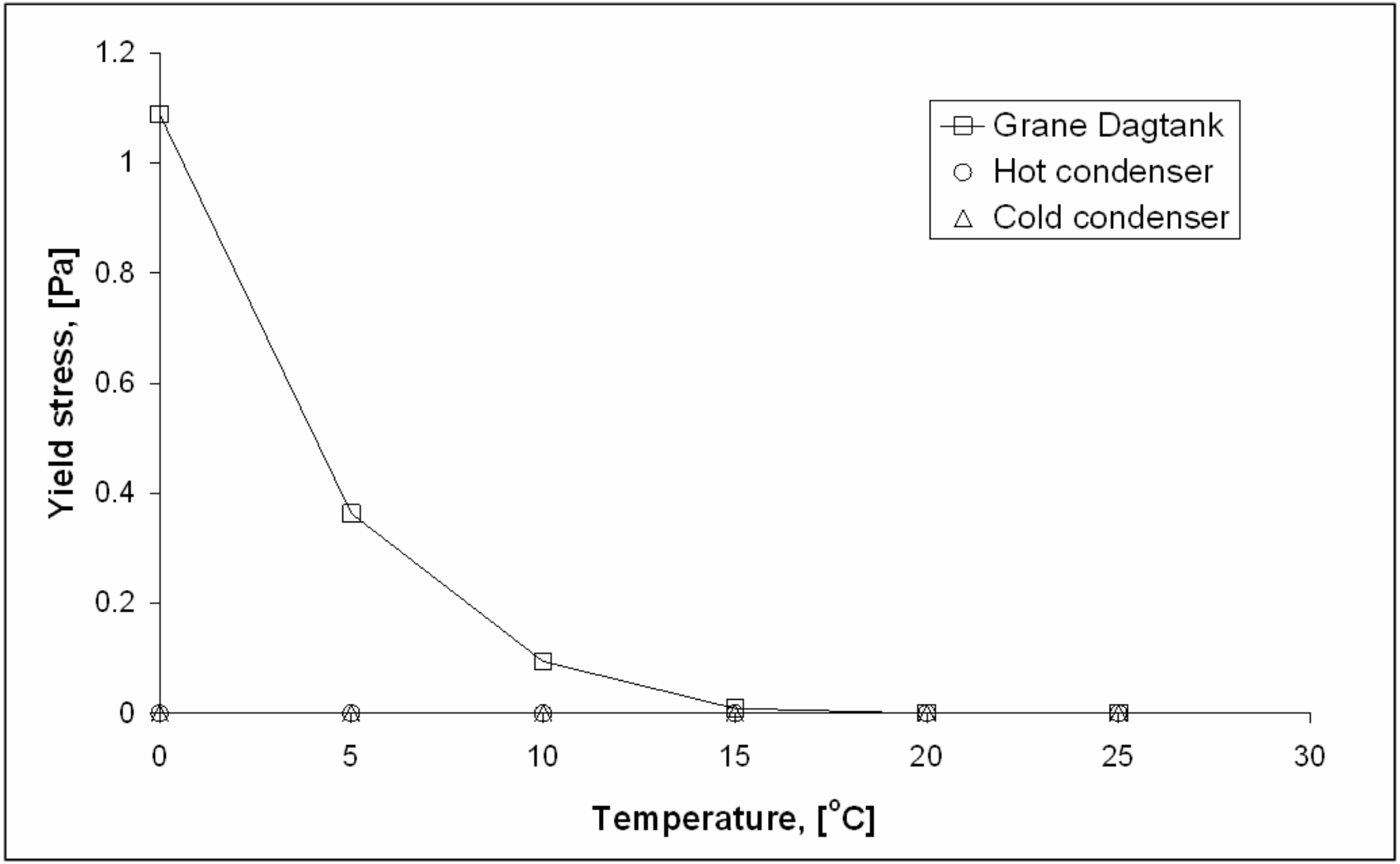
Table 4. Viscosity [cP]

T deg.C	Grane crude	Hot condenser	Cold condenser
25.0	241	8.86	1.88
20.0	355	10.8	2.09
15.0	537	13.3	2.33
10.0	843	16.7	2.64
5.0	1382	21.5	3.02
0.0	2331	28.4	3.48

Results of Grane oil – Viscosity (1)



Results of Grane oil – Viscosity (2)



Business Idea

Ellycrack AS will alone or with an industrial partner develop, refine and commercialize Ellycrack´s technologies, which offers substantial economical and environmental benefits to heavy oil producers.

Ellycrack intend to create value by generating income and profit based on what clients want of either:

- **Production sharing**
- **Licensing**
- **Leasing**
- **Sale of plants**

Strategy

Develop Ellycrack to a level where the future potential value of the technologies are clearly visible. Then search for exit alternatives as sale of company or listing the company on a stock exchange.

Short term strategy:

1. **Prepare the pilot plant for new extensive testing**
2. **Invite heavy oil producers to test their oil on the pilot plant**
3. **Discuss further commercial issues with these oil producers during the test period**
4. **Secure sufficient funding to develop the company according to chosen business plan**

Summary of Key Benefits

- Eliminate the cost of purchase and transport diluent oil
- Increasing the value of the oil with USD 25-30 in a single operation at a cost of USD 3-5 per barrel
- Payback on investment for a client between 1 and 2 years
- Easy to fit into existing infrastructure on the oil field
- Reduce CO_2emissions for upgrading with 60% (calculated)
- Ellycrack represents a high value added factor which reduces business risk significant by securing a higher value of the oil