



# Anticipate and react on time

## Optimize your steam cracker operations

Quality variations and switches of the steam cracker liquid feeds are common, frequent and mainly depend on spot imports.

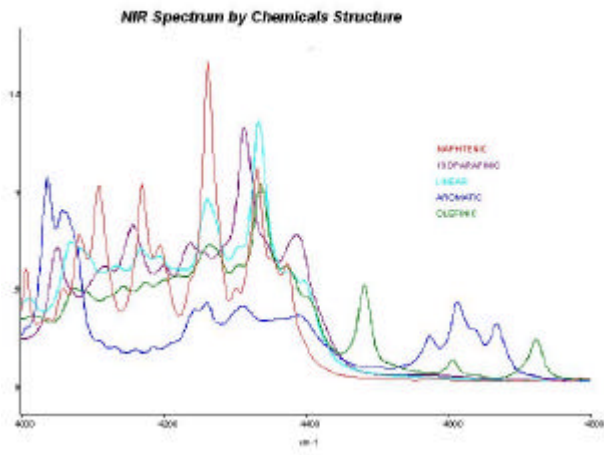
Conventional analyzers cannot detect such variations on time, leading to important production losses.

The fast reactivity of NIR combined with the high accuracy and robustness of Topnir model insures dramatic improvement of the process efficiency.



### TECHNOLOGY SUMMARY

The PIONA character (Linear Parafin, Iso Parafin, Naphthenic, Olefin and Aromatic) is very well correlated to some specific wavelength in the NIR spectrum range.



Topnir predicts the steam cracker liquid feeds key properties on real time.

For Naphtha feed, the model is able to output the Carbon by Carbon PIONA as well as the density, the molecular weight, the potential yields of Ethylene and propylene...

In addition of monitoring the feed properties, the system can be configured to also predict the Pyrolysis Gasoline.

Property	Reference	Prediction	Property	Reference	Prediction
DENS	0.6897	0.6895	SumC4	0.00	0.00
IBP	34.5	34.8	fetButen1	0.00	0.00
E10	49.9	51.7	fetButen2	0.01	0.01
E30	62.9	64.1	CycloPent	0.00	0.01
E50	81.8	82.5	SumC5	0.02	0.04
E70	107.7	107.5	SumC6	0.02	0.03
E90	138.2	137.6	tot0	0.04	0.07
E95	149.3	149.3	CycloPent	0.63	0.64
FBP	171.2	170.4	CycloHexe	1.10	1.10
nButan	2.98	2.61	SumC6	3.46	3.39
nPentan	14.16	14.36	MetCycloH	2.01	2.06
nHexan	9.80	9.79	SumC7	4.01	4.05
nHeptan	6.28	6.30	SumC8	3.95	4.16
nOktan	4.21	4.34	totH	12.05	12.27
totP	40.68	40.80	Benzol	0.50	0.52
iButan	0.33	0.26	Toluol	1.50	1.51
iPentan	11.00	11.06	SumC8	2.36	2.42
iHexan	10.92	10.78	totA	5.98	5.88
iHeptan	6.47	6.35	RestK	5.58	5.40
iOktan	4.85	4.95	Bromahl	0.32	0.38
totI	35.68	35.76			

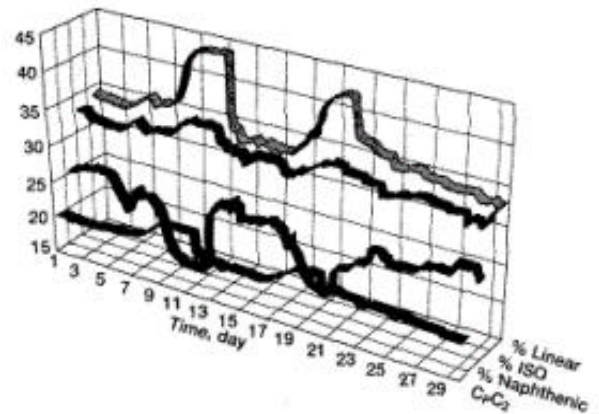
### INCREASE BENEFITS

#### Maximize Advanced Process Control efficiency

- Increase throughput
- Improve olefins yields
- Push the process toward measured quality constraints
- Maintain the process on constraint
- Minimize Process fluctuation

#### Maximize Feed switch efficiency

- Minimize transition time
- Minimize transition associated risks



#### Increase furnaces run length

- Use Topnir coke knowledge into the optimizer

#### Save energy

#### Improve safety

**Savings: 2- 5 M\$/Year**

**Return on investment capital less than 5 months**



**KEY ADVANTAGES**

**Accurate and robust model**

The predictions accuracy ensures a tight control on key properties. In addition, the Topnir robustness allows accounting for large feed quality range of variation.

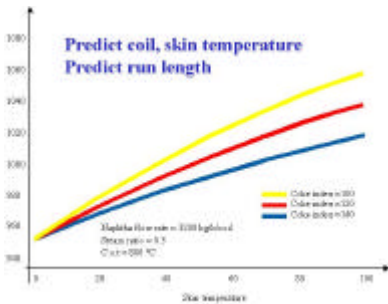
**Easy model maintenance**

Topnir research and development has accounted for the weakness of traditional Partial Least Square models maintenance, that rapidly becomes a bottleneck when the application involves a lot of properties, each requiring a specific calibration treatment.

Topnir is based on robust and none regressional approach that do not require specific model update. Thanks to the self-learning methodology, Topnir model is easily maintained up to date only with regular addition of new samples into the database.

**Coke index calculation**

By measuring the feed coke index, Topnir goes beyond a simple analyzer and brings more added value in the optimization chain.



**Easy integration with existing APC and optimization**

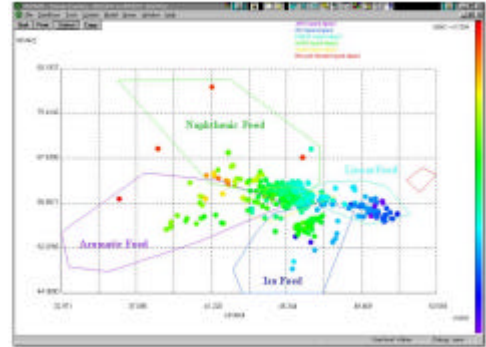
Topnir outputs the quality information to the DCS to feed the existing advanced process control and optimization systems. Moreover, the decoking scheduling of radiation tubes and transfer line exchanger can be done through the coke index delivered by Topnir.

These indices, specific to given feedstocks, are used to predict the coke rate and skin temperature.

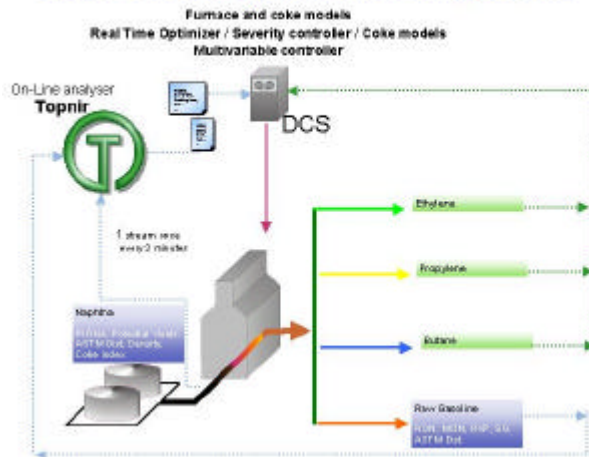
**User friendly and powerful graphical interface**

Topnir provides the operator with a efficient graphical representation to monitor, simulate and anticipate process variation.

Specific spectral aggregates have been defined to handle the spectral discrimination and spectral pattern recognition.



**Steam Cracker Optimization using Topnir**



**REAL CASE STUDY**

Ethylene production: 1 MT/year ; Naphtha feed from spot market.

**INCREMENTAL BENEFITS ON CDU (REAL CASE STUDY)**

ITEM	YEARLY SAVINGS (\$)
Increase Ethylene production	3 M
By increasing throughput	
By Improving olefin yields	
By optimizing feed and campaign switch efficiency	
By increasing furnace run length	
Save energy	Not estimated
<b>YEARLY GLOBAL SAVING</b>	<b>3 M \$</b>

**OPTA-PERIPH TOPNIR SYSTEMS ALLIANCE**

