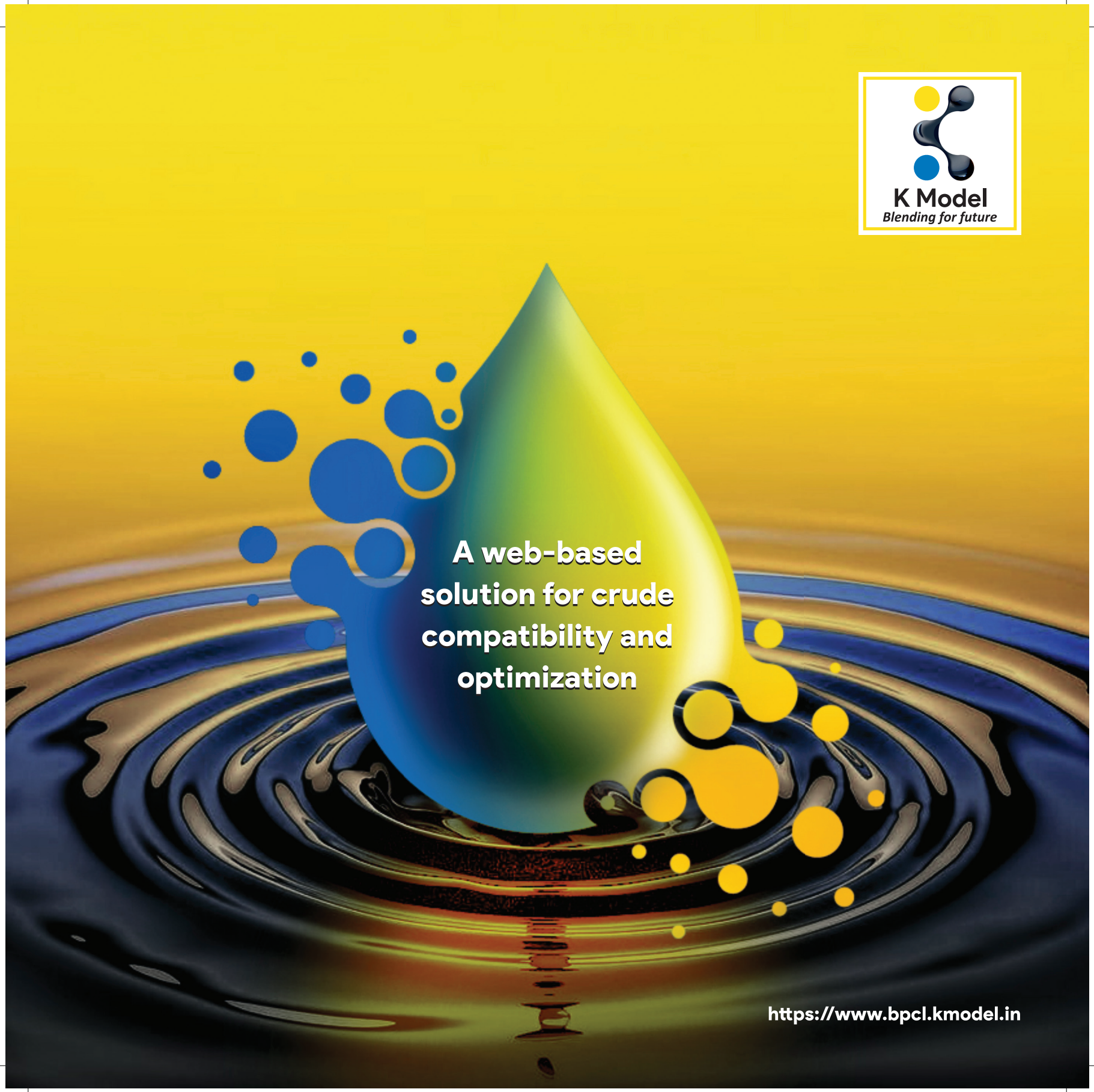

K Model
Blending for future
A web-based solution for crude compatibility and optimization
https://www.bpcl.kmodel.in

The importance of crude oil blending

In order to increase the gross margins, refineries often process a blend of crude oils rather than a single crude oil to ensure that an optimum product mix can be obtained at minimum cost. In this regard, refineries are always looking for ways to increase co-processing of heavy or opportunity crude oils with light crude oils without facing operational issues.

Challenges in crude oil blending

Heavy crude oils have a high amount of paraffin or asphaltene or both as difficulty. When there is high paraffin content, it results in high viscosity and high pour point making transportation difficult. On the other hand, a high asphaltene content causes flocculation and/or precipitation, instability, and incompatibility which in turn can affect the desalter operation by strong water emulsions with asphaltene, fouling in heat exchangers means excess fuel firing and emissions, and/or coking issues. If this happens, refineries can lose more than the advantage of purchasing the heavy or opportunity crudes. Thus, accurate prediction of crude compatibility is an irreplaceable tool that refinery operators would like to use before starting any process.

Finding compatible blends is a necessity

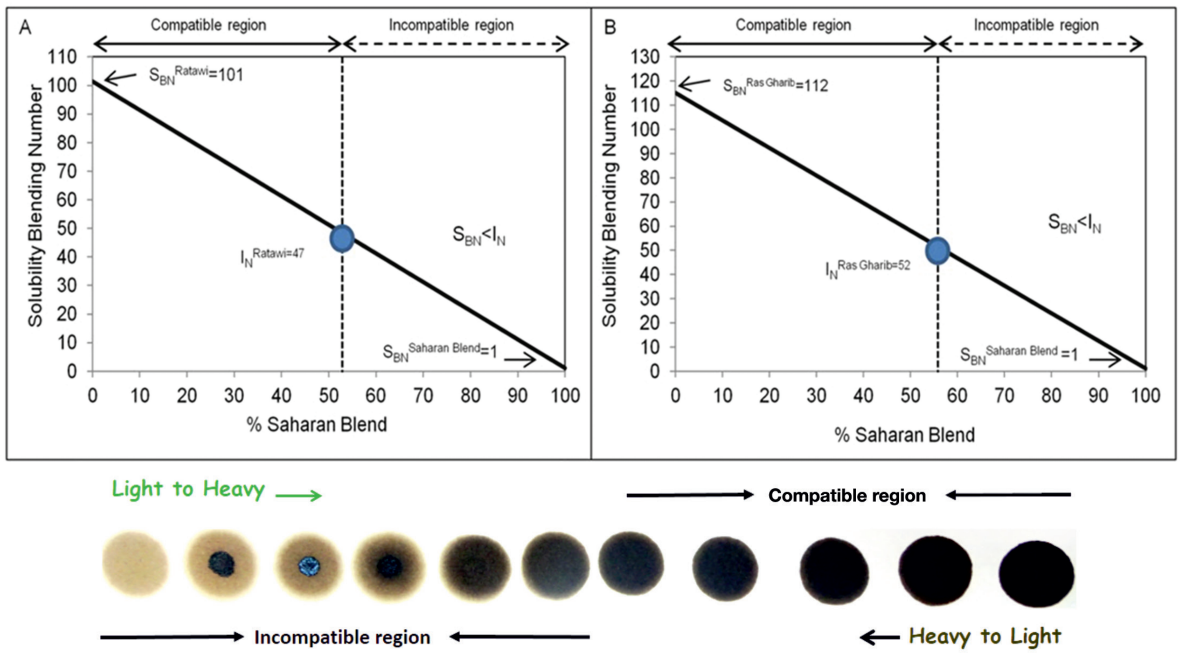
The ability to predict compatibility of crude oil blends will have significant impact on margins especially for refiners who have large number of crude mix to process. For refineries, where 4 to 10 crude oil of different origin are likely to get mixed in some proportion or the other, predicting compatibility will be a necessity. Current benchmark processes to determine compatibility of two crudes is done experimentally and takes minimum one week's time to complete.

BPCL introduces an accurate and faster solution

The R&D team of BPCL addressed the challenge of optimizing blends with K Model, which helps in quick and accurate prediction of crude oil compatibility. K Model helps crude sourcing teams to identify which crude is best suited and also being used for regular monitoring of Asphaltene flocculation to precipitation behaviour in refinery operation, depending upon the desired refinery output. K Model can also predict compatibility of intermediate streams within various refining units. This unique feature can predict incompatibility hotspots in various unit operations employed in refining units.

Congruence with Laboratory Test Results

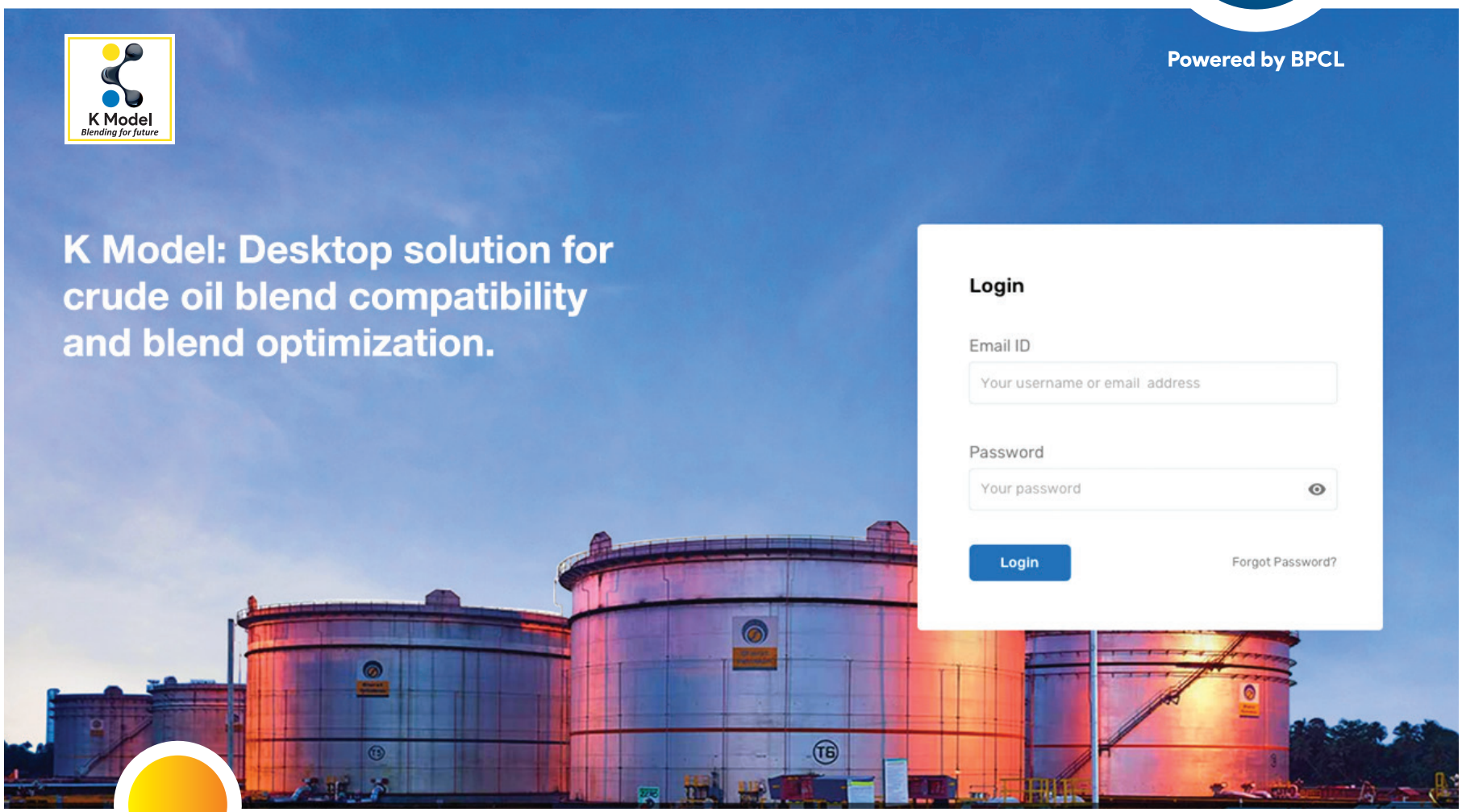
K Model predicts the composite results of nine well known compatibility test methods with an accuracy of ± 1 wt%. Compatibility results of K Model along with Oil Compatibility Method (OCM) and Spot Test method for Ratawi/Saharan blend and Ras Gharib/Saharan blend are depicted below:



K Model accurately predicts Asphaltene flocculation to precipitation behavior

K Model is based on in-depth characterization of Asphaltene molecules of oils for compatibility and processability. Phase separation in desalting and temperature change in heat exchangers are well corroborated with K Model solution.

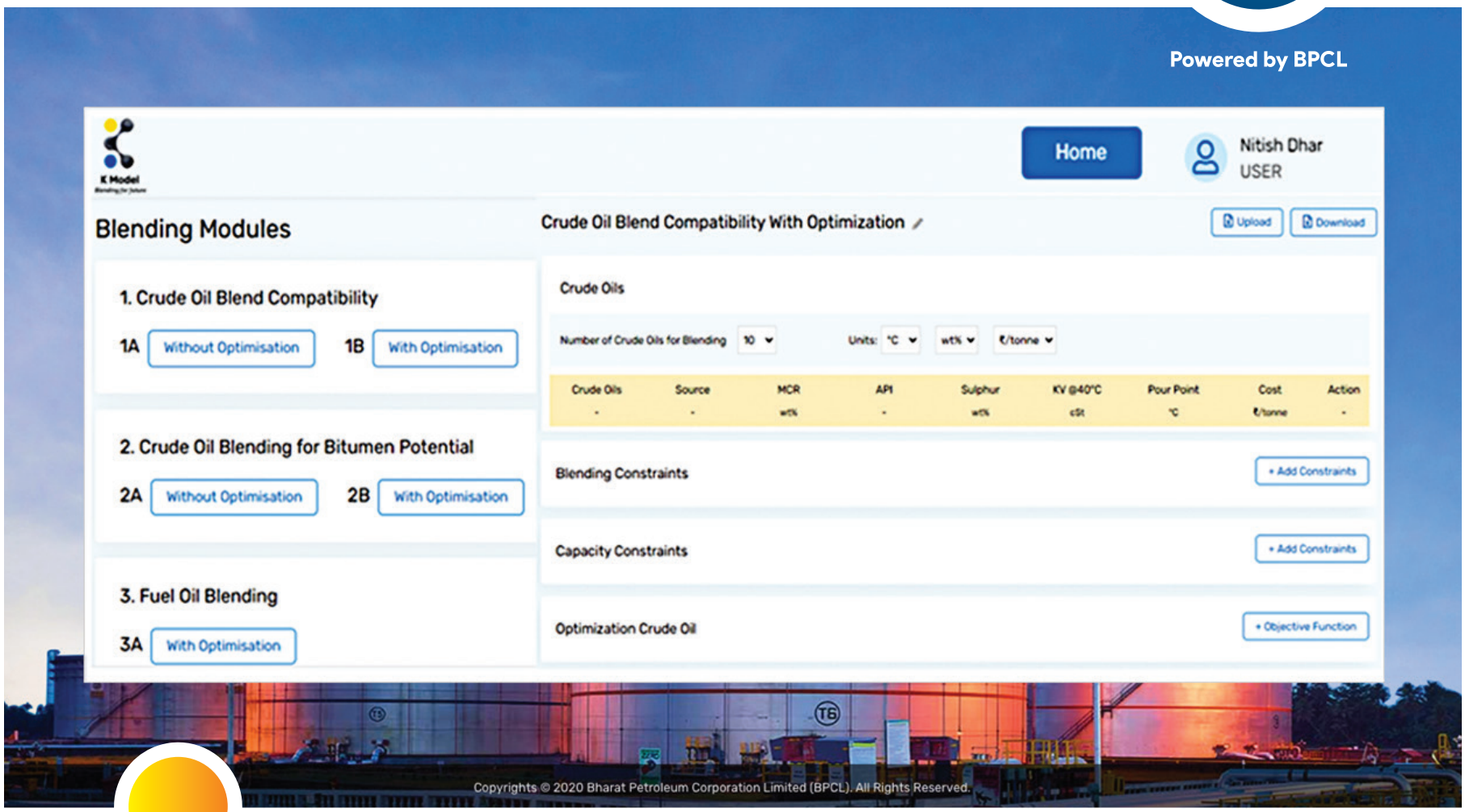
K Model: A web based software for crude compatibility and optimization



K Model requires physical parameters as input for quick and accurate prediction of crude oil blend compatibility and blend optimization of any number of crude oil blend within minutes. K Model enables refiners to arrive at an optimum compatible crude oil blend based on economics, availability and processing feasibility on real time basis, thereby promoting simultaneous evaluation of multiple blend options in quick time and take more informed decisions. K Model is a web-based software to predict results rapidly at https://www.bpcl.kmodel.in.

K Model software modules

Powered by BPCL



The K Model software package offers different modules that provide variety of options to meet refinery blending needs. It has three modules as:

1) Crude Oil Blend Compatibility – 1A without optimization / 1B with optimization,
2) Crude Oil Blending for Bitumen Potential – 2A without optimization / 2B with optimization and
3) Fuel Oil Blending – 3A with optimization.

Testimonials

K Model is successfully implemented in BPCL group refineries, supply chain optimization, International trade for heavy / opportunity crude oil selection and crude mix processing.

Suresh Nair
Ex-Executive Director
(BPCL, Supply Chain Optimization)

"K Model can be a real game changer in the coming years in terms of crude oil selection and crude parcel schedule preparation. Integrating K Model application in Crude oil procurement can facilitate quick decisions in finalizing optimal blends based on availability and financial considerations."

V. R. Rajan
General Manager
(BPCL, Mumbai Refinery)

"K Model provides refiners the ability to predict compatibility of crude oil blends with 10 crudes of different origin. The only proven alternatives known are experimental or empirical in nature which are severely constrained either by time required to predict or the applicable ranges of the sample characteristics."

Chacko M. Jose
Chief General Manager
(BPCL, Kochi Refinery)

"The most remarkable feature of K model is its ability to predict compatibility of more than two crude oil blend within few minutes. This ability to check the compatibility of a blend adds new dimension to crude oil selection. Unknown blends can be readily chosen while selecting the crude parcels."

Sanjay Bhargava
Ex-Executive Director
(BPCL, R&D)

"K Model results are highly accurate as compared to the benchmark known in the industry for any predicting tool. The functioning of the application might appear to be heuristic but in actual the underlying governing equations were derived well proven compatibility indexes and corresponding experimental results. Overall, the results predicted are accurate enough to support business decisions flawlessly."

Anand Pratap Raghav
Vice President
(Bina Refinery)

"K Model, though primarily developed for predicting blend compatibility of crude oil, can also predict compatibility of intermediate streams within various refining units. This unique feature can predict incompatibility hotspots within refinery and thereby provides opportunity to deploy suitable mitigation strategy to improve the performance of these units."

Ravitej P. V.
Executive Director
In-charge (BPCL Refineries)

"K Model has no competitor in the market, and this is a very unique solution developed by our R&D Team. No commercial application or tool has the capability to predict compatibility of two or more crude oil with overall optimization in such a rapid time frame. This tool has proved its worth for quick business decisions. I think, this is a must have for refiners."

Implementation

So far more than 2000 crude combinations (involving ~ 200 different crudes) analyzed for processing opportunity crudes and resulted refinery margins of about 15 cents/barrel to $2/barrel over regular crudes.

Awards & Recognitions

K Model received several National/ International Awards

1. Winner of 'Golden Peacock Innovative Product/ Service Award' for the year 2021.
2. Best Innovation in R&D Institute Award 2019/20 by Ministry of Petroleum & Natural Gas (MoP&NG).
3. PETROTECH-2019 'Special Technical Award' for Innovation in Hydrocarbon Sector.
4. Best Poster Presentation Award in Refining and Petrochemicals Technology Meet (RPTM-2019)
5. First Runner Up Award 2019 in 'Process Innovation Leadership' category by Frost & Sullivan.
6. US Pat. No. 10,365,263 (June 2019) Granted in One Year.

CORPORATE R&D CENTER
BHARAT PETROLEUM CORPORATION LIMITED
Plot No. 2A, Udyog Kendra, Surajpur Industrial Area,
Greater NOIDA, U. P. 201306 (India).

Tel.: (+91)-120-2354133, Mob.: (+91)-9313817141,
Email: dlcrdcsupport@bharatpetroleum.in