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WELCOME

NEXTADIUM

FASTER APPROACH TO DISTILLATE MAXIMIZATION IN ATMOSPHERIC COLUMN

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Project Genesis

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

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CDTI
Centro para el Desarrollo Tecnológico Industrial

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5th INDIA – SPAIN PROGRAMME OF COOPERATION ON INDUSTRIAL RESEARCH AND DEVELOPMENT

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Agenda

- Little bit about us
- The business problem
- The new approach
- Results and beyond
- Q & A

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Little bit about us

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Little bit about us

- Equinox (Est: 2005)
- Provides IT enabled chemical engineering consulting services
- Delivered more than one million man hours services since inception
- Serves 100+ clients in 15 countries
- ISO 9001 and 27001 Certified
- Works with leading OEMs as Independent Services Provider

- Nextadium (Est: 2003)
- More than 15 years bringing together EMEA and APAC businesses, people and technologies.
- Main focus in high-tech companies and process industries sector.
- Extensive network of partners with wide expertise in corporate strategy.
- Adepts to digital transformation and cross-cultural collaboration.

Equinox – OEM Universe

Amongst the largest software platform independent companies in CPI/HPI

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The Business Problem

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Problem statement from the Refiner

- The refinery is processing a mix of crudes
- After a crude- change and/ or a process conditions change (based on mode of operation), there is a stabilization period to normalize the process and get on-spec. products.
- To reduce this transient period, refinery is looking for an accurate but easy to use steady-state simulation application

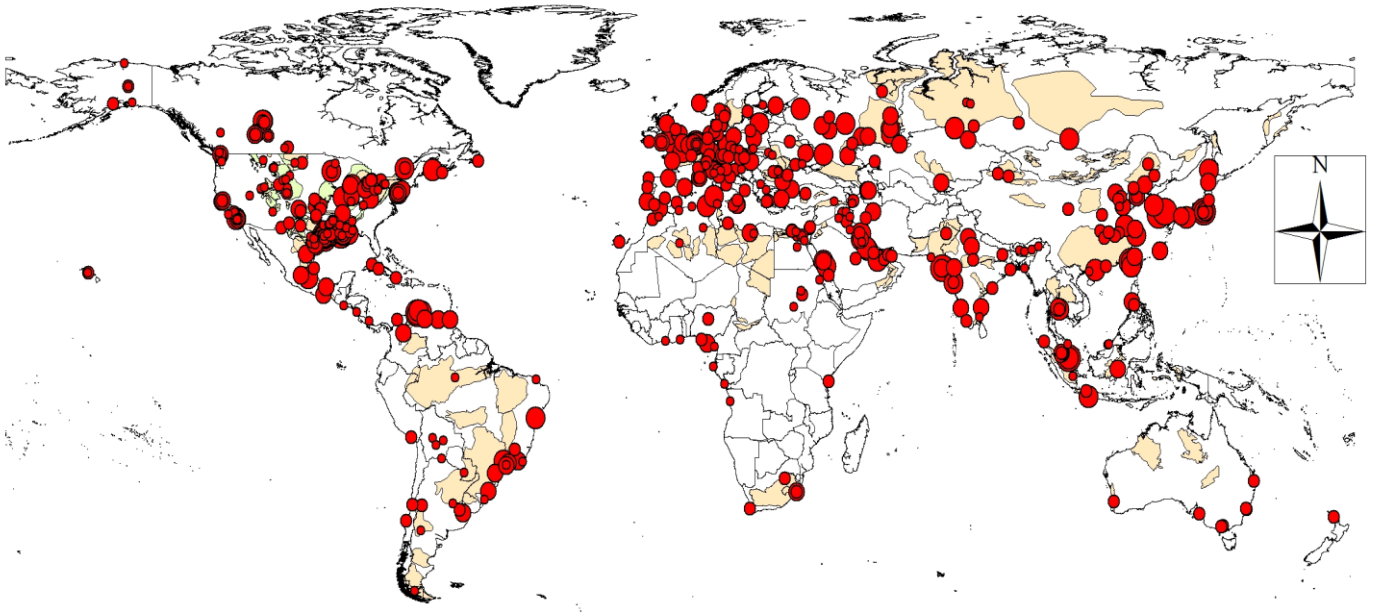
Problem statement from the Refiner

- ……..

"…..As stated in section 1.0 of this document, XYZ witnesses frequent crude change cases. Sometimes two or more crudes are blended and fed into the unit. This requires setting the process conditions appropriately so as to get on- spec. products as desired. XYZ expects the simulation models to help reduce the transition period by minimum 50%...."

Basis for product development

- Changes on crude feedstock is very common for a refinery
- Refiners expects the simulation models to reduce the transition period by minimum 50% of time



The Business Problem

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Objective

- To build a digital representation of CDU
- To predict CDU operating conditions, quickly within, say less than thirty minutes

Background

- Crude mix changes every 2 days
- Current CDU model takes longer time, often with many convergence issues

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Current Business Process

Time T = 0

Unit Charge = Running + New Crude

T = 4-6 Hours

Unit Charge = Only New Crude

Time = 4-6 Hours

Stable operation with New Crude

Time=20-30 Hours

Time to cut-n Next Crude

48-60 Hours

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The new approach

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What is the new approach

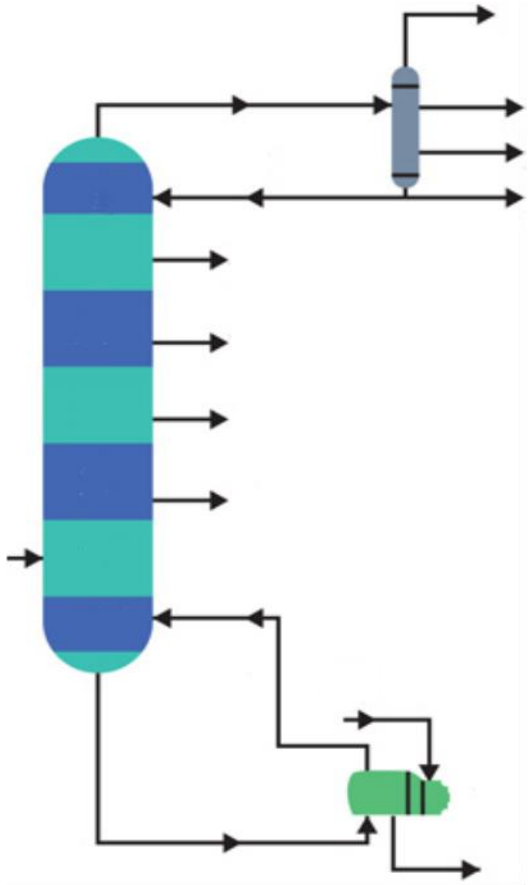
- Hybrid Modeling
- Combine plant data with fundamental model
- Use past data to extract various model parameters
- Extract, Store, Use a large set of models, for various crudes and conditions

What is the new approach

- A new business process aided with a new APP
  - Application is now ready, tested and working
  - Implemented in Python with a GUI.
- Easy to implement and manage by any refinery
- Proven and tested and working in other refineries.

What is the new approach

- Refiners wish to find out the operating conditions for the new crude oils
- Refiners also wish to take advantage of market conditions and maximize the most profitable product at a given time
- So they also need optimum operating conditions to maximize the production of Liquid Distillate of their choice



What is the new approach

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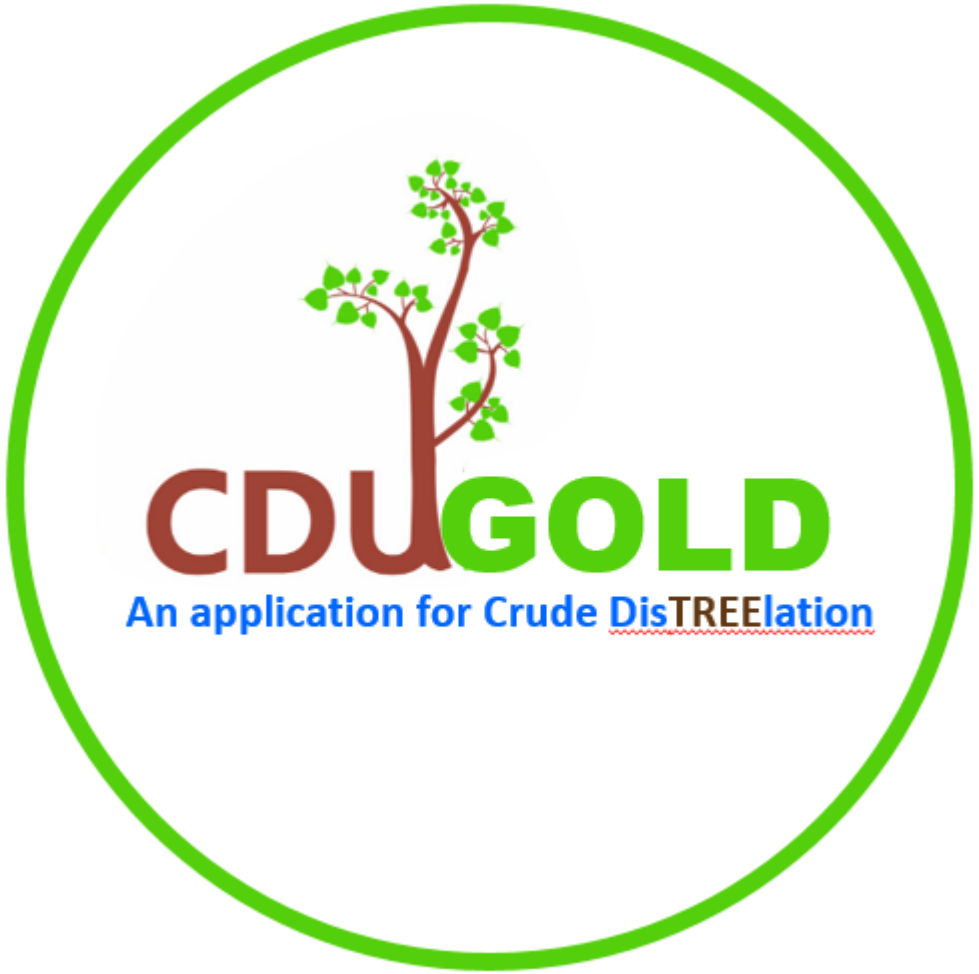
Introducing **CDU.GOLD** = **G**lobal **O**ptimization **L**iquid **D**istillate



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The Solution

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Input

- Crude Assay
- Physical column configuration
- Past operating data for calibration
- Desired Distillate and Quality

Output

- Optimum Operating Point

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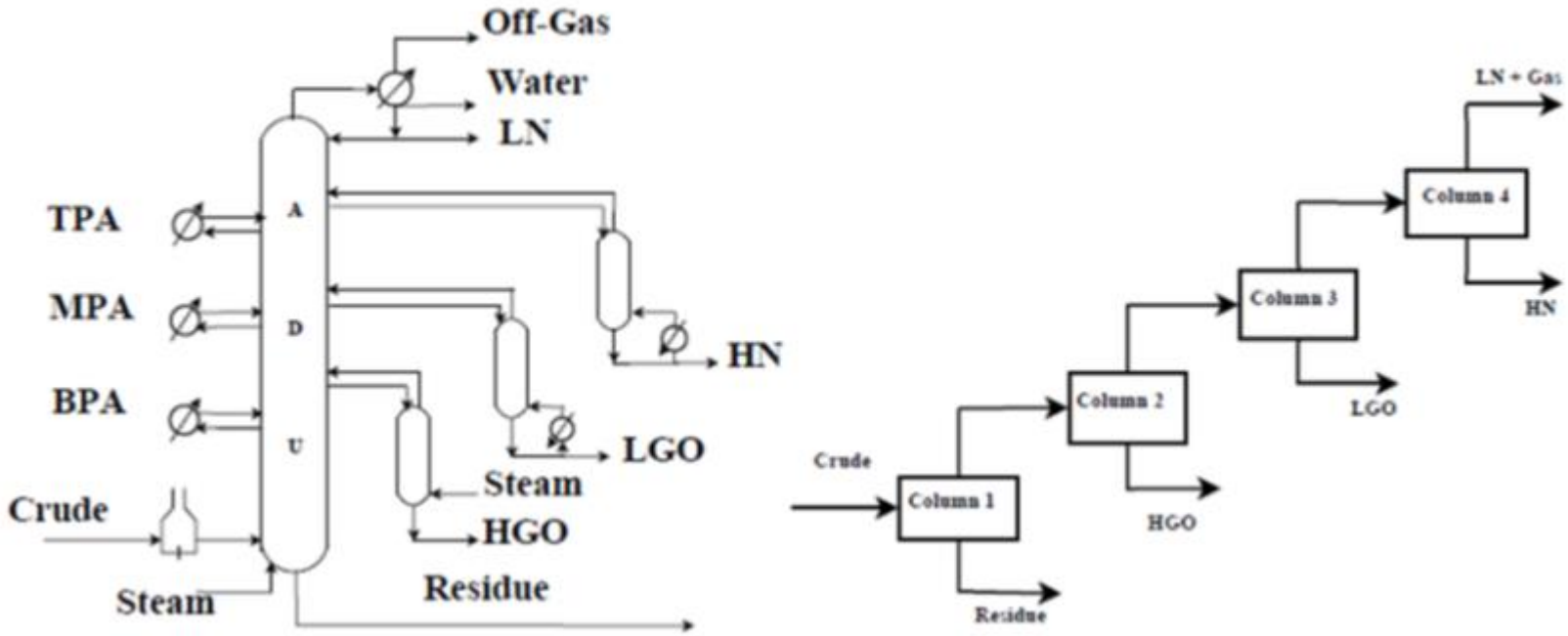
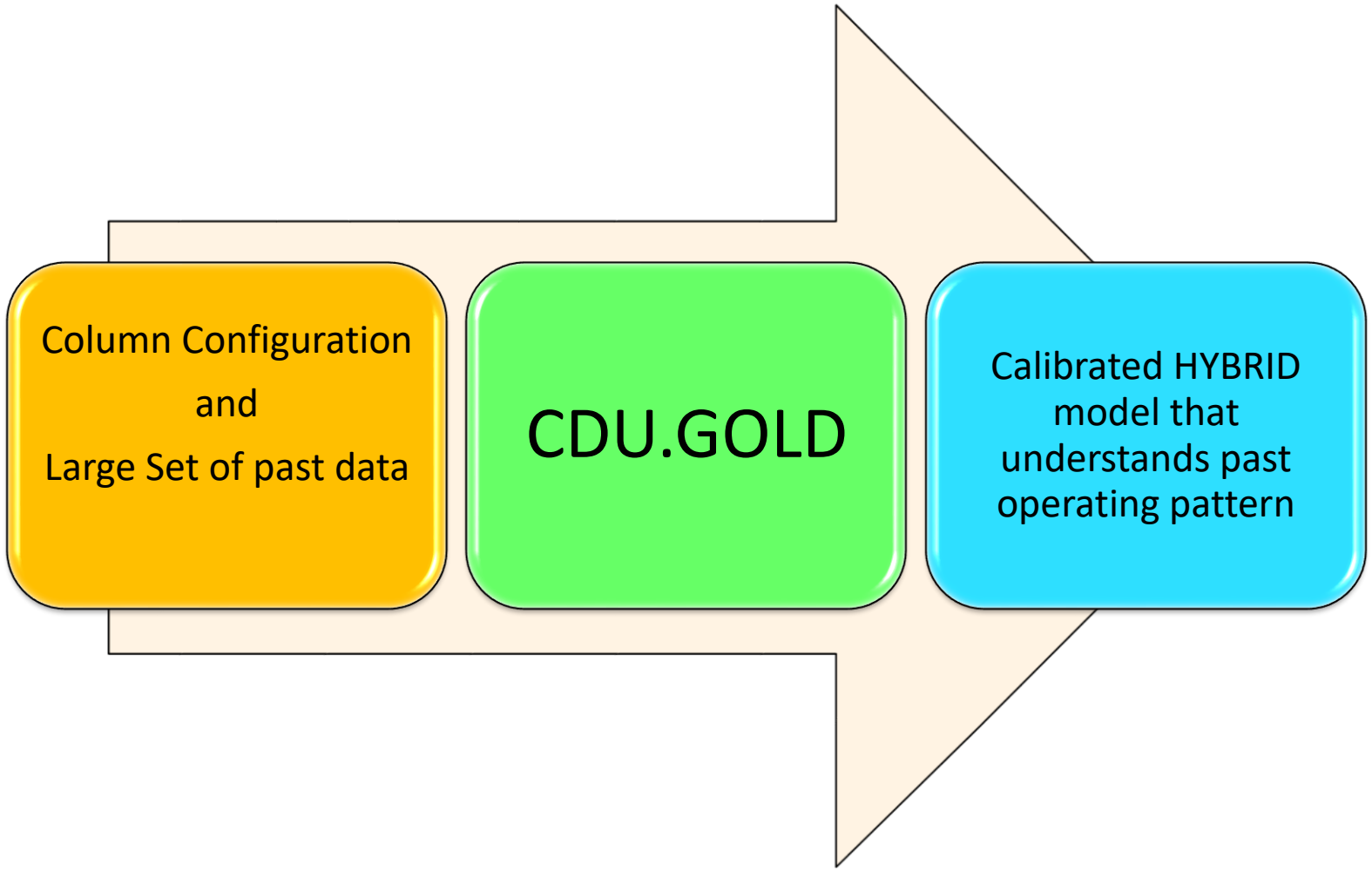
New Algorithm

- Step-1: Build a Hybrid model of the unit



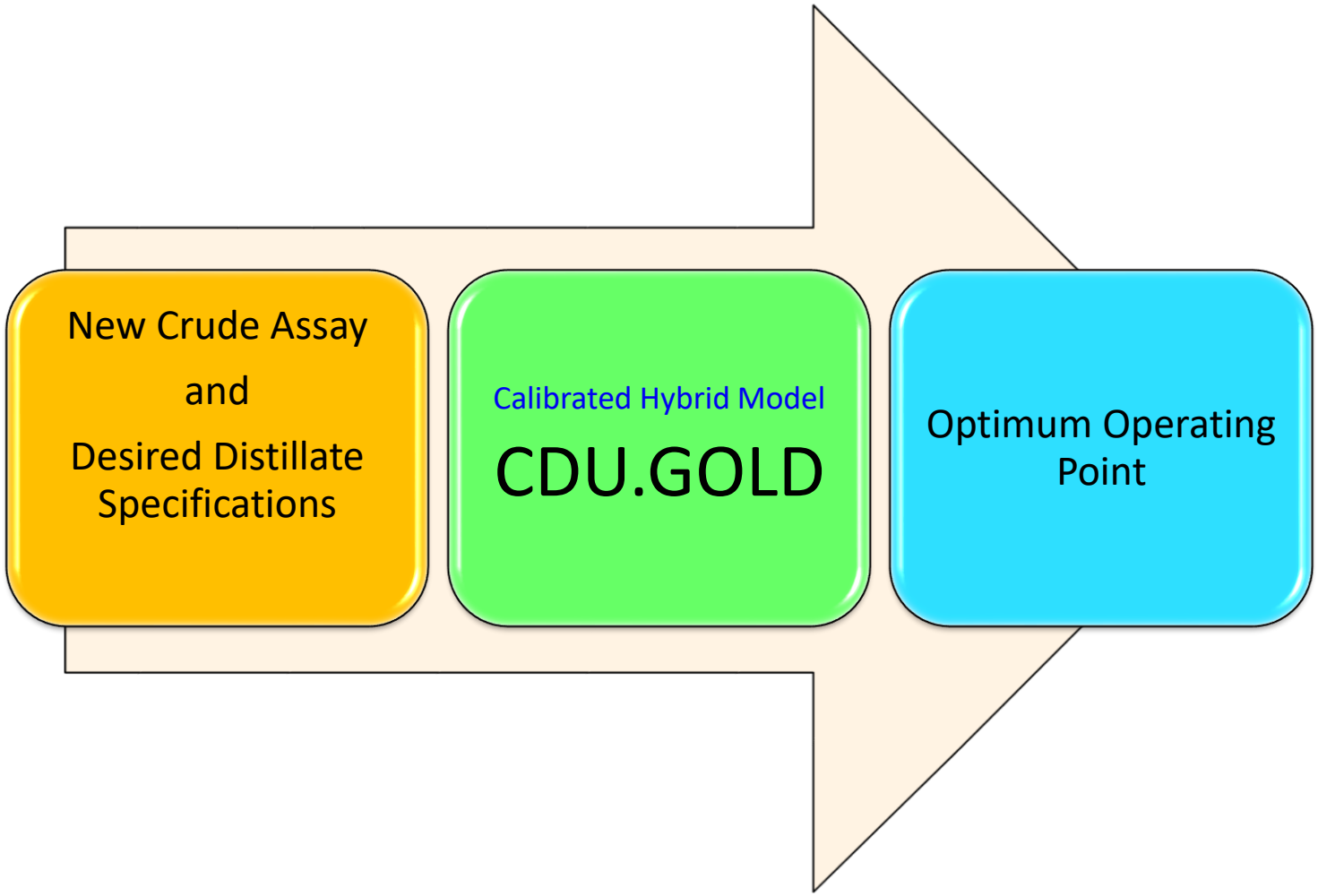
New Algorithm

- Step-2: Use past operating data to calibrate the plant model



New Algorithm

- Step-3: Use the calibrated model to predict the operating conditions



Comparasion with present technologies

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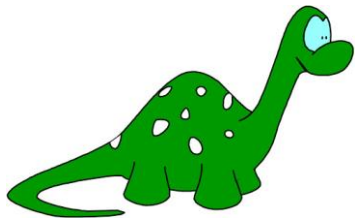
- **Present technologies**
  - Software are bulky,
  - Difficult to configure, run and maintain,
  - Requires considerable human effort to converge,
  - High cost, takes long time to implement,
  - Skill is in short supply.



- **Proposed technology CDU.GOLD**
  - Lightweight,
  - Low cost. Easy to configure, run and maintain
  - Requires little effort,
  - Robust convergence,
  - Takes short time to implement
  - Easy to learn, easy to teach and even easier to sustain.

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Results and Beyond

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Case Study

- An Asian Refiner
  - CDU of 330 K BBL/Day
  - Originally designed to process Basrah Mix
  - Currently processes a mix of crudes
- After a crude- change and/ or a process conditions change (based on mode of operation), there is a stabilization period to normalize the process and get on-spec. products.

Case Study

- Objective, as stated by the refiner in its RFP:

"…..As stated in section 1.0 of this document, XYZ witnesses frequent crude change cases. Sometimes two or more crudes are blended and fed into the unit. This requires setting the process conditions appropriately so as to get on-spec. products as desired. XYZ expects the simulation models to help reduce the transition period by minimum 50%...."

Description	Refinery-I
Calibration	
API	34.1
Prediction	
API	32.7

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Refinery – I : Calibration

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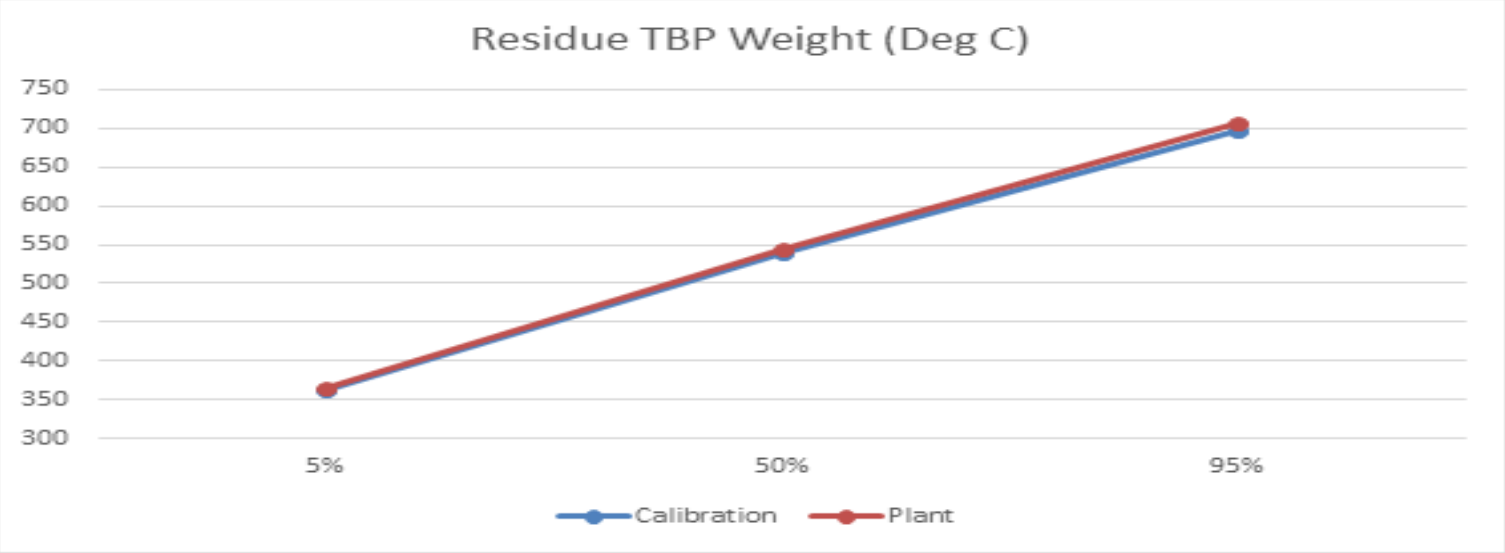
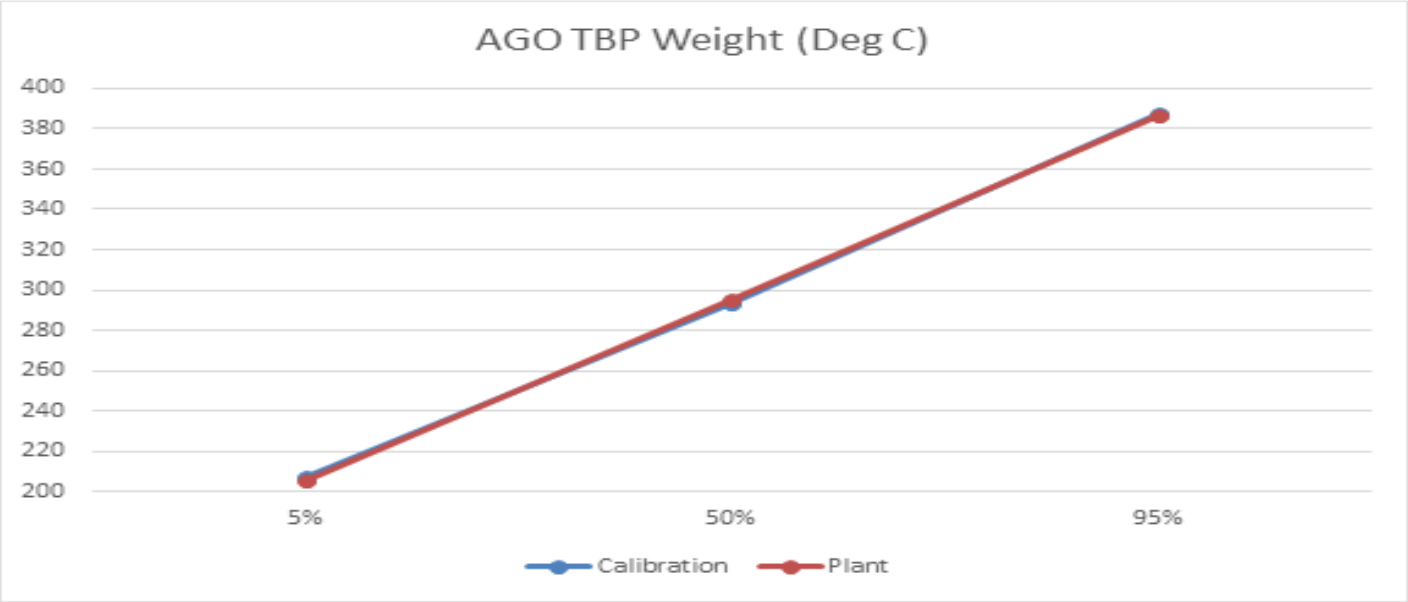
Calibration Results: Refinery I: API 34.1



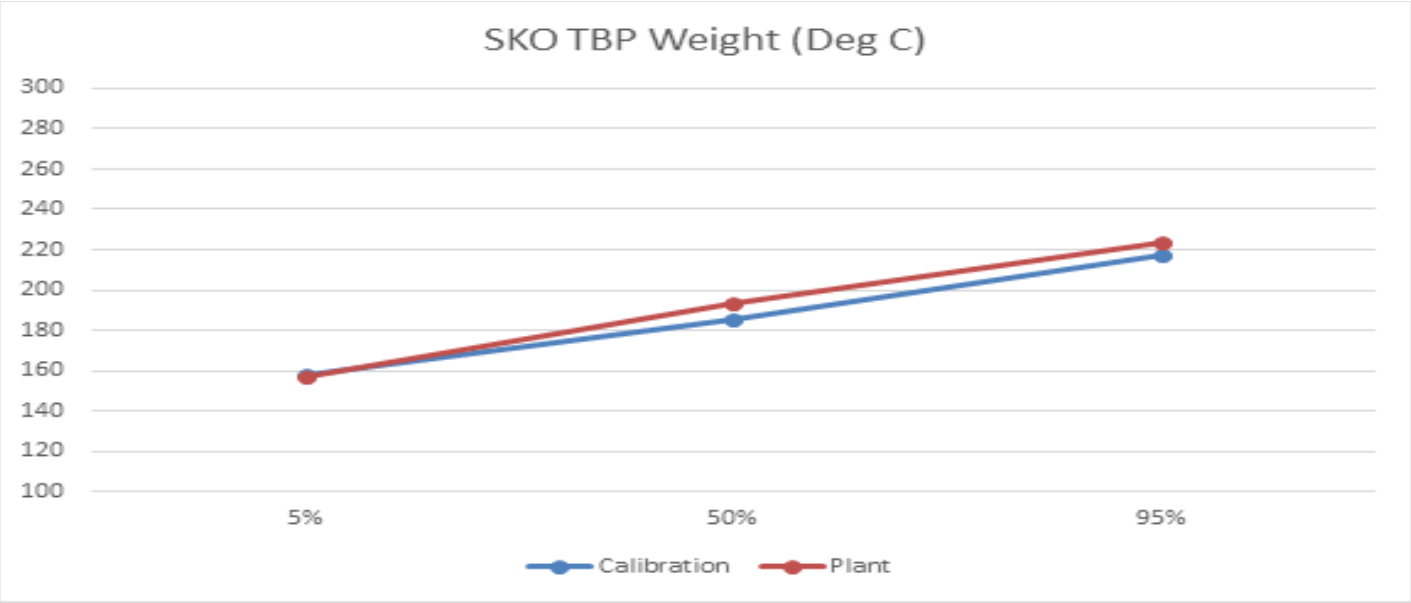
Residue	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Calibration	1741	363.3	539.7	696.6
Plant	1741	364	543.9	706.8
% Deviation	-0.02	-0.19	-0.77	-1.44

Calibration Results: Refinery I: API 34.1



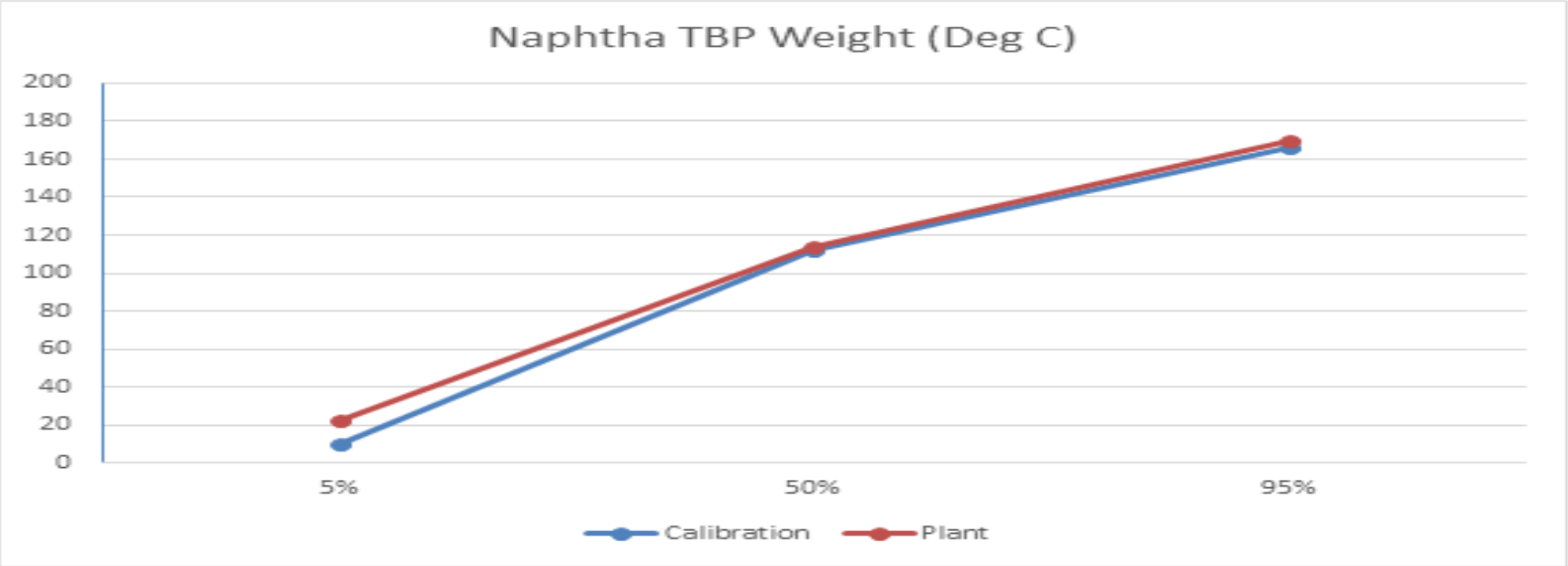
AGO	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Calibration	1884	207.4	293.2	387.7
Plant	1884	205.2	295.4	386.3
% Deviation	0.0	1.07	0.76	0.37

Calibration Results: Refinery I: API 34.1



SKO	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (DegC)	TBP Wt 95% (Deg C)
Calibration	737.7	157.5	185.7	217.7
Plant	737.9	157.0	193.4	223.5
% Deviation	0.0	0.3	-4.0	2.6

Calibration Results: Refinery I: API 34.1



Naphtha	Flow (kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Calibration	3241	9.46	111.6	166.2
Plant	3242	22.01	114.2	170.1
% Deviation	-0.02	-57	-2.25	-2.27

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Refinery – I : Prediction

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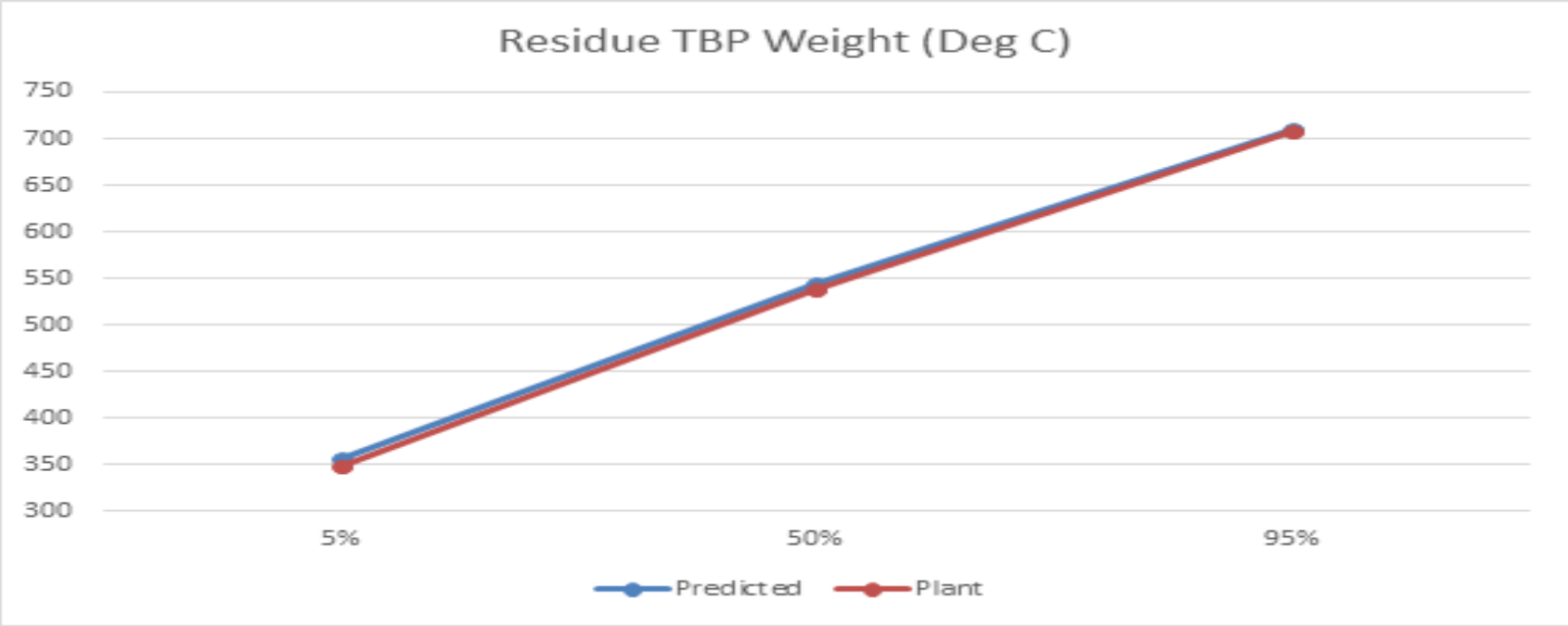
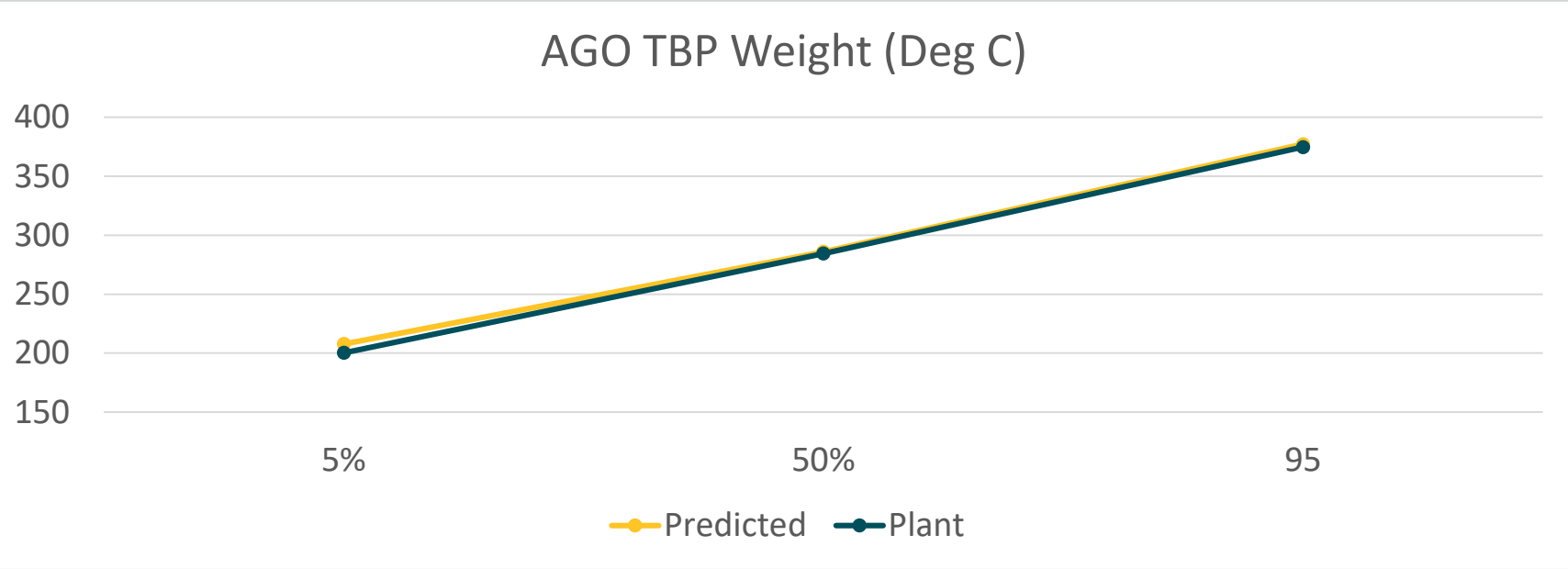
Prediction Results: Refinery I : API 32.7



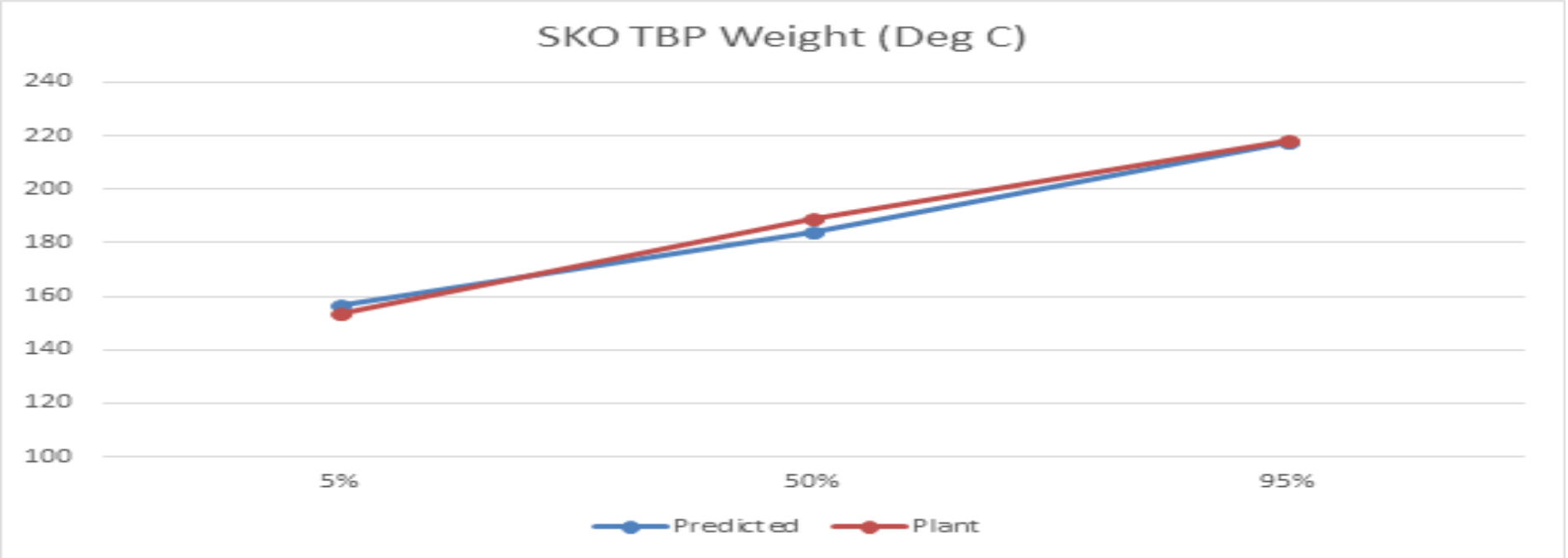
Residue	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Prediction	1859	356.8	544.9	709.4
Plant	1878	348.9	538.8	708.2
% Deviation	-1.01	2.26	1.13	0.17

Prediction Results: Refinery I : API 32.7



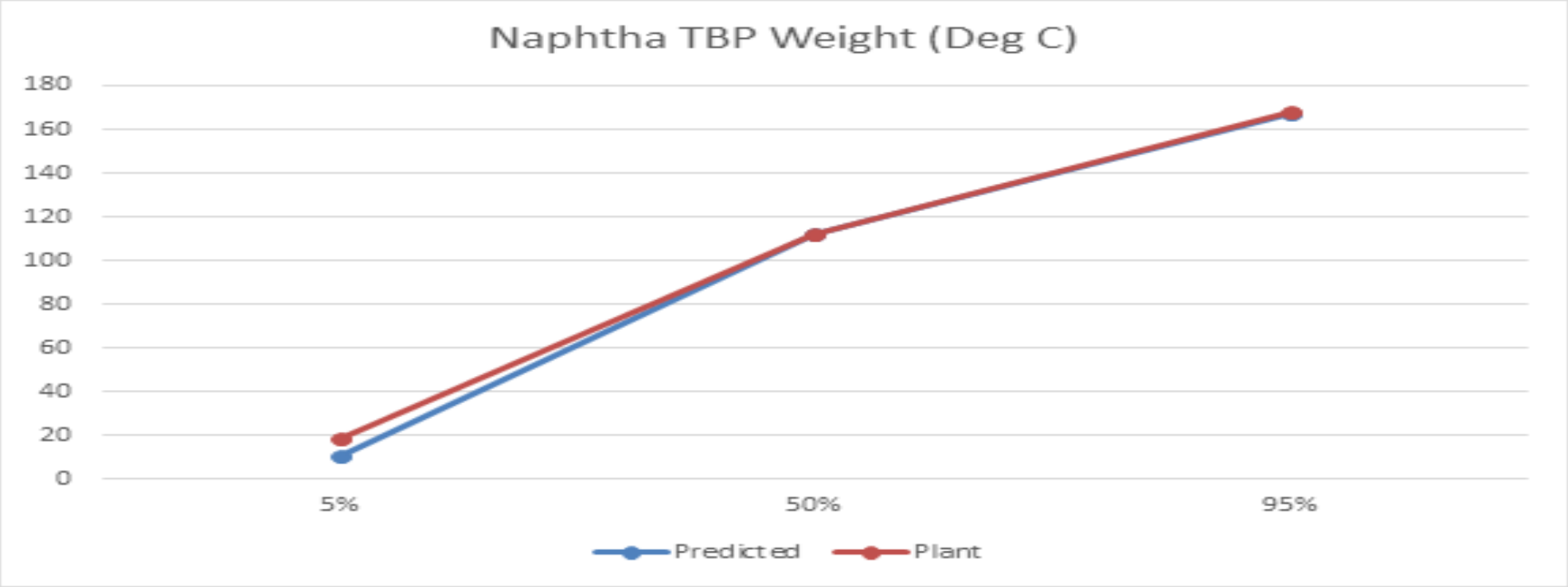
AGO	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Prediction	1975	207.7	285.9	377.2
Plant	1980	200.2	284.4	374.8
% Deviation	-0.25	3.75	0.53	0.37

Prediction Results: Refinery I : API 32.7



SKO	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Prediction	851	156.5	183.9	217.8
Plant	753	153.8	189.2	217.9
% Deviation	13.01	1.76	-2.8	-0.41

Prediction Results: Refinery I : API 32.7



Naphtha	Flow (Kmoles/Hr)	TBP Wt 5% (Deg C)	TBP Wt 50% (Deg C)	TBP Wt 95% (Deg C)
Prediction	3303	10.2	112.1	166.9
Plant	3383	18.38	111.9	167.8
% Deviation	-2.36	-44.5	0.18	-0.54

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Refinery – I : Optimization

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Findings

- The optimization case returns with a higher SKO production

Feed/Product	Units	Prediction Case	Optimized Case	Optim
Feed	API	32.7	32.7	
Feed	K BBL/Day	330	330	
Residue	K BBL/Day	149.5		
AGO	K BBL/Day	83.4		
SKO	K BBL/Day	25.5	26.1	2.35%
Naphtha	K BBL/Day	70.4		
LPG + Off-Gas	K BBL/Day	1.2		
Total	K BBL/Day	330	330	

- That translates into an annual savings of 1.15 – 1.56 M USD

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CDU.GOLD: Screen Shots

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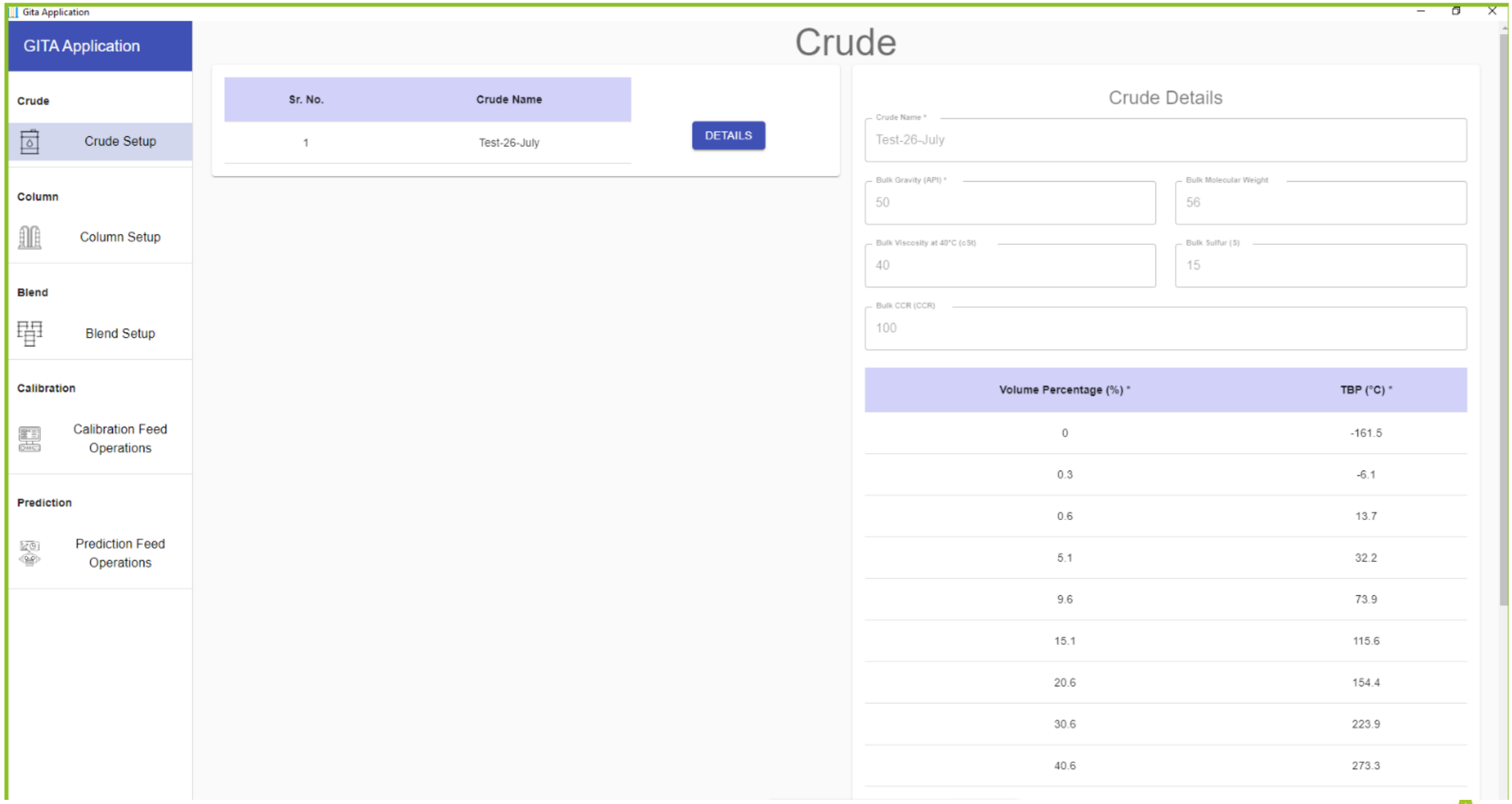
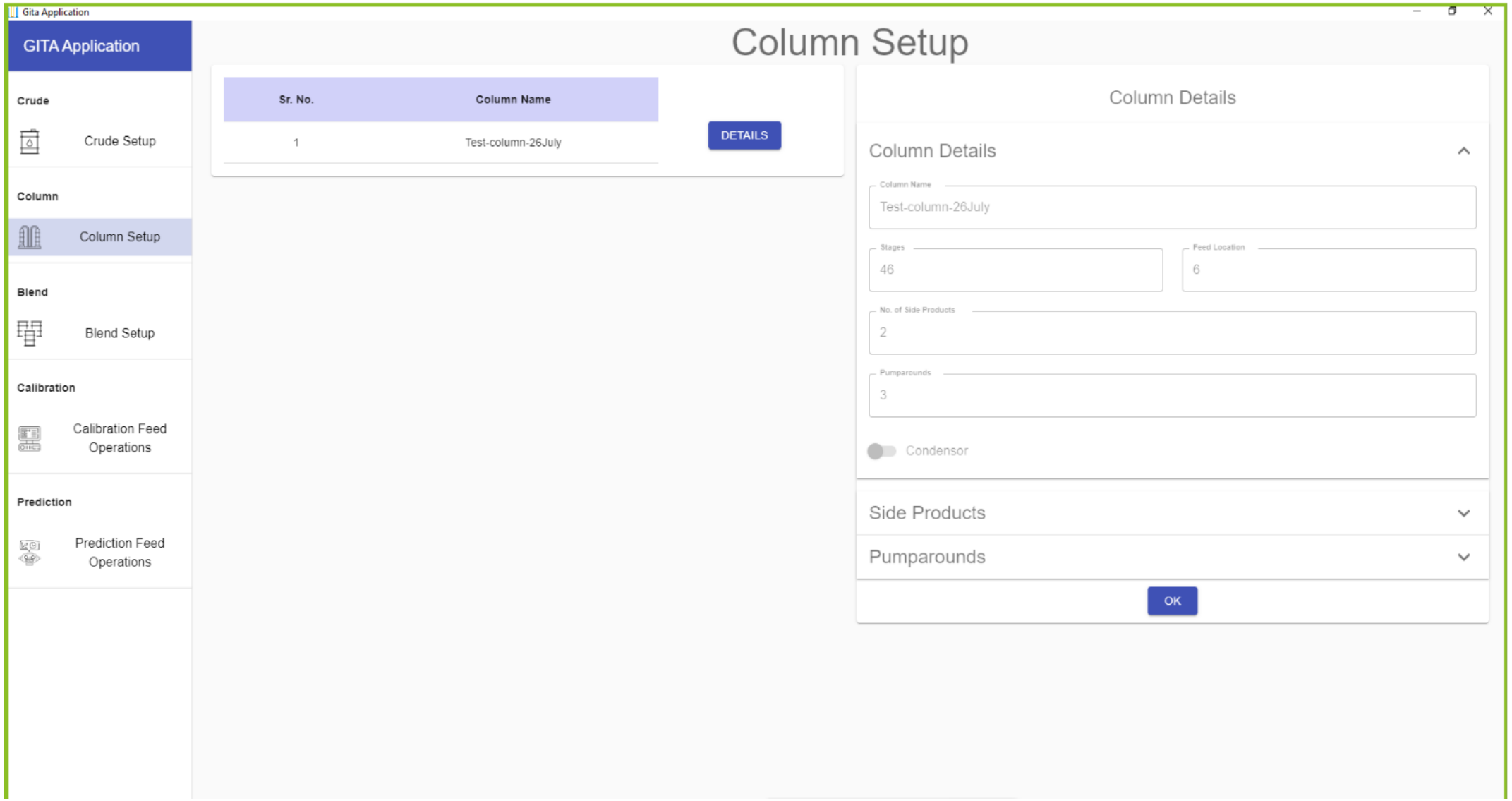
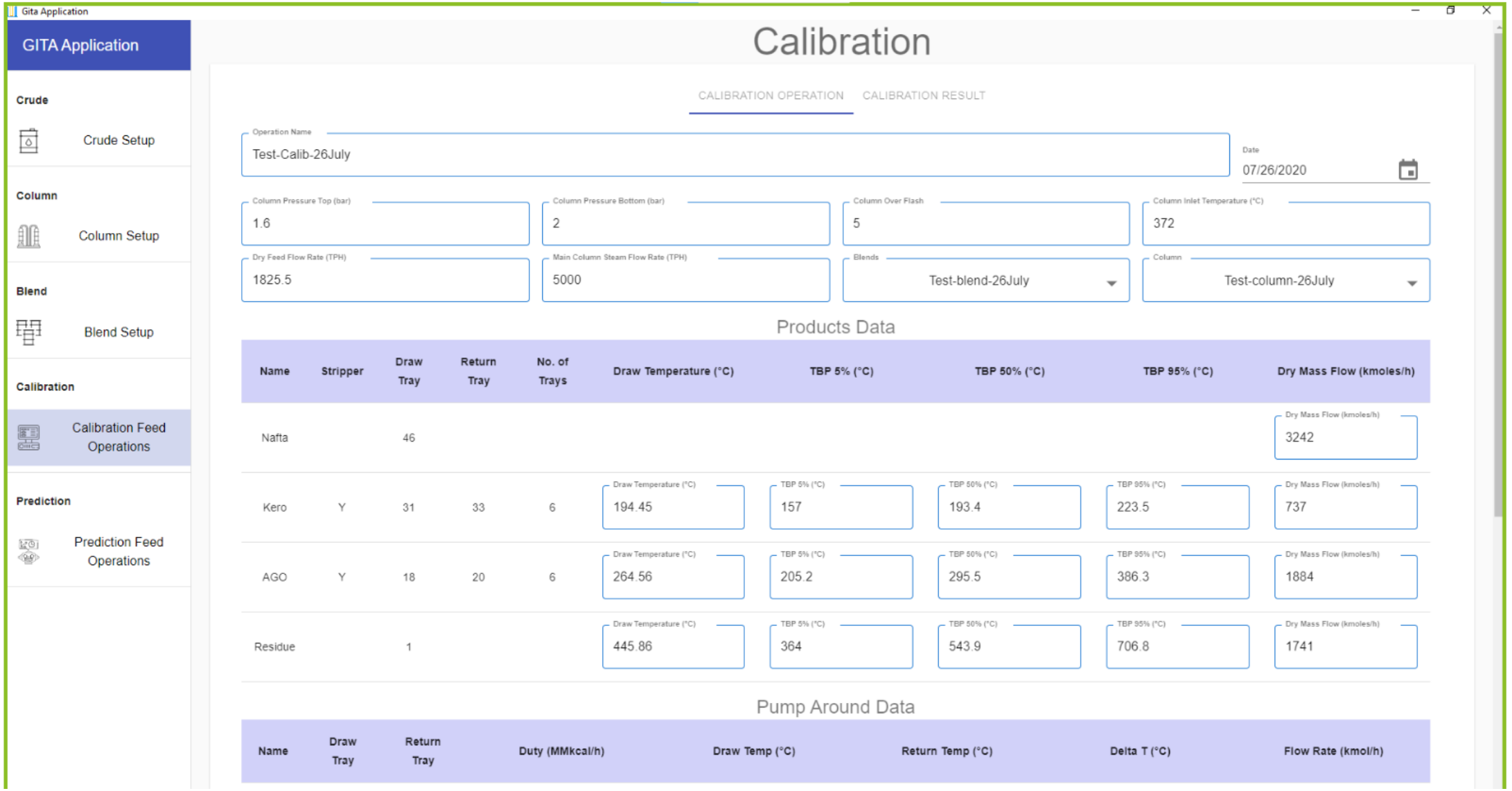
Crude Setup



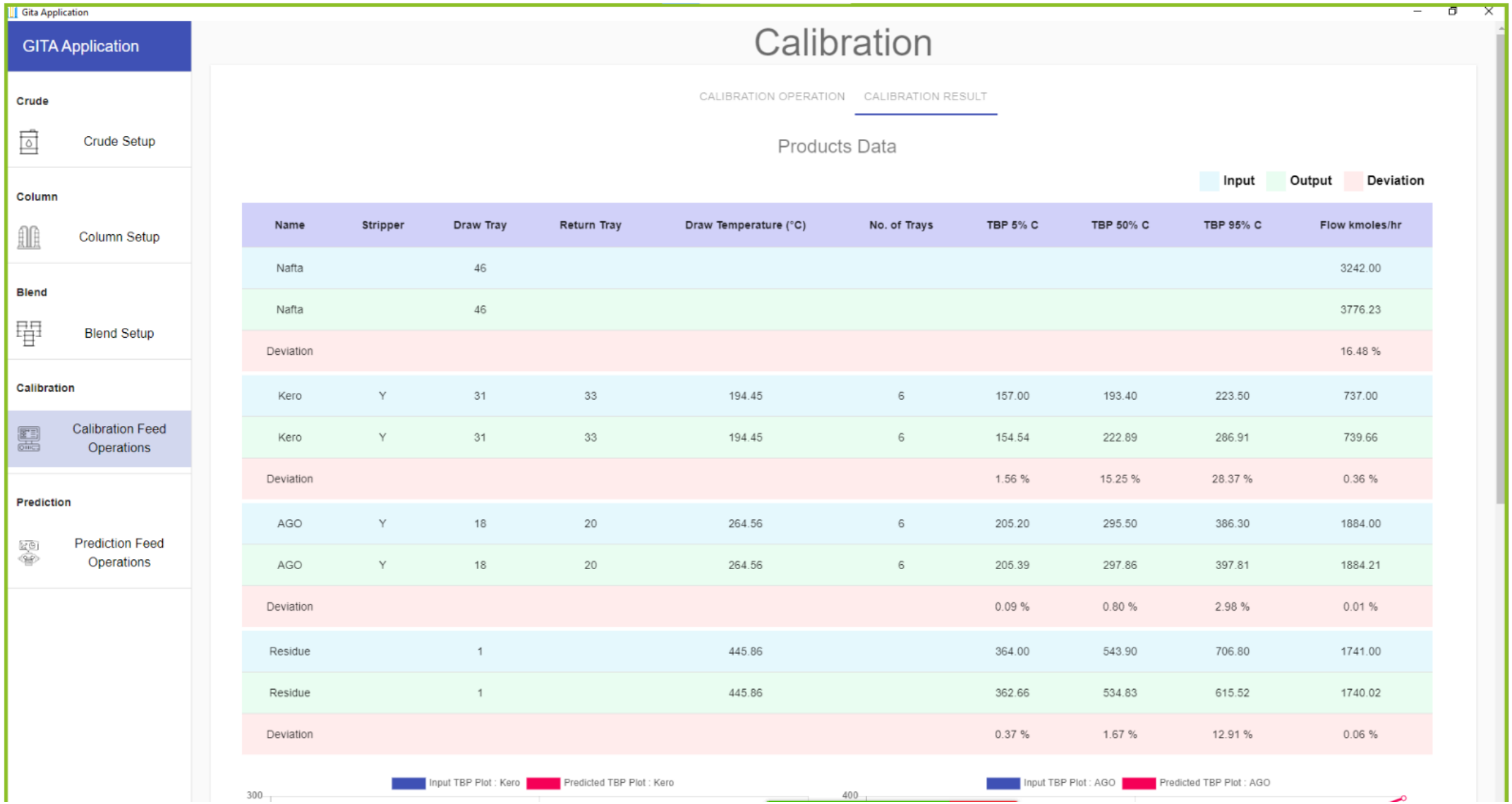
Column Setup



Calibration

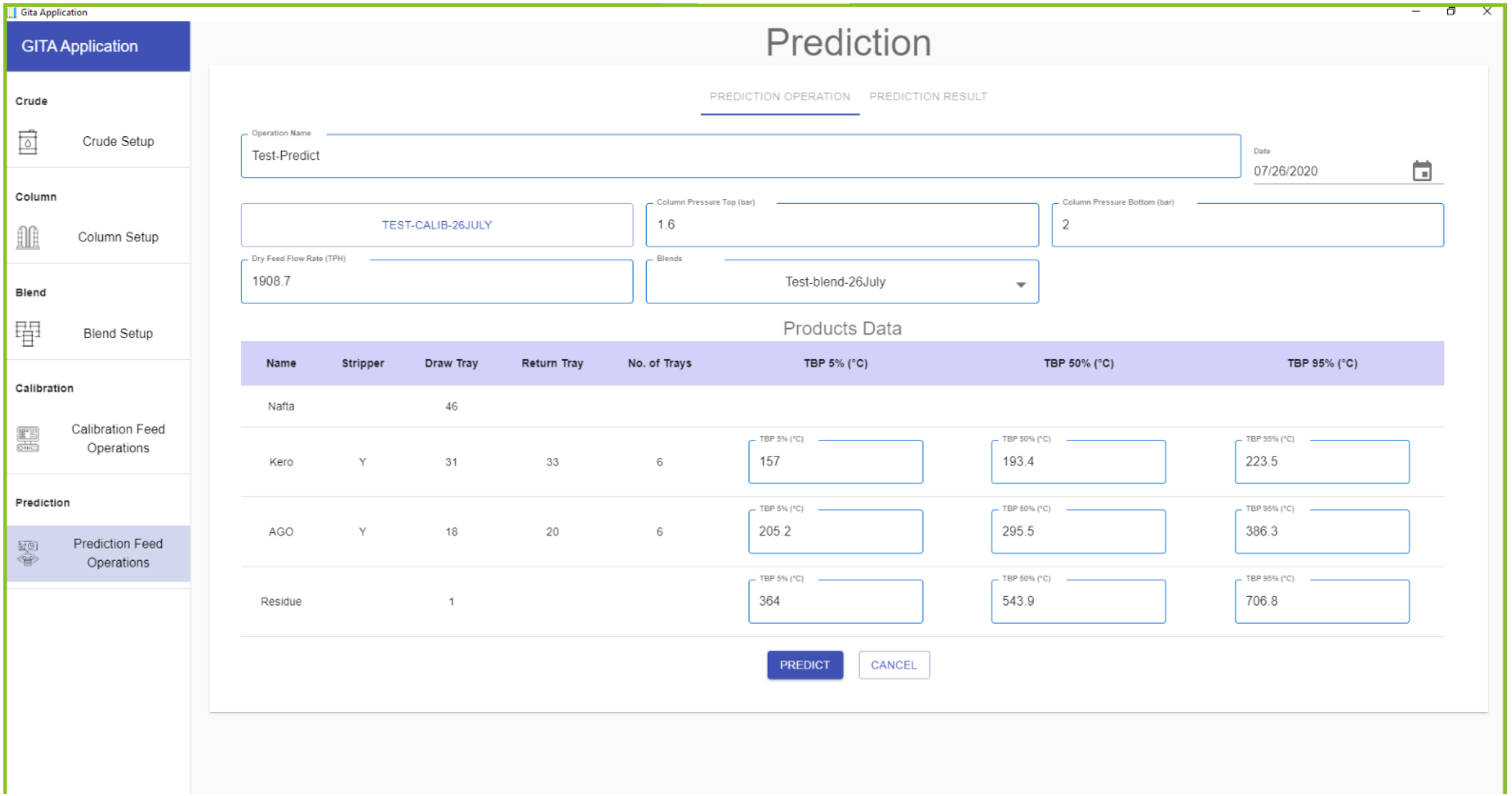


Calibration Results

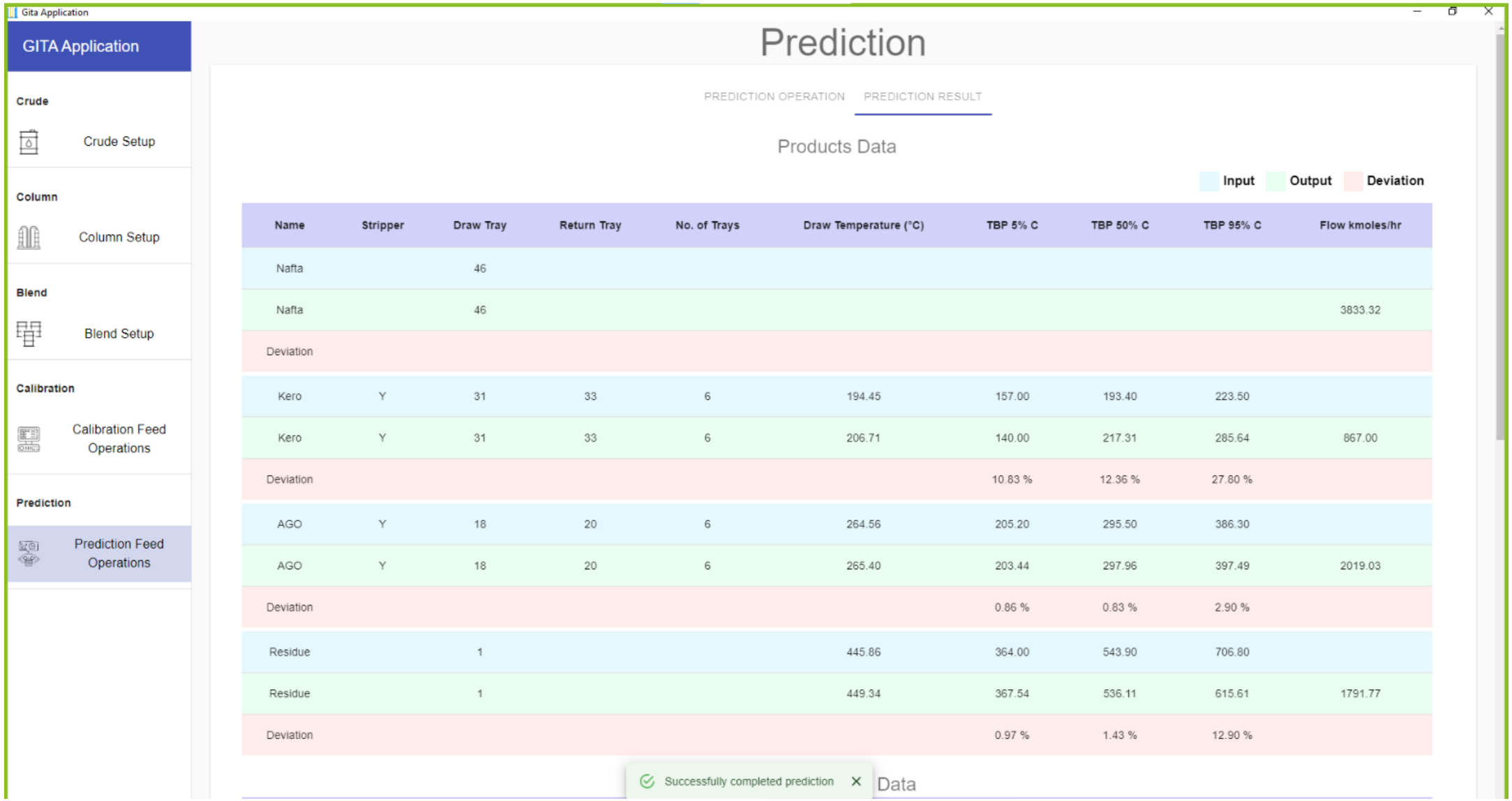


Name	Stripper	Draw Tray	Return Tray	Draw Temperature (°C)	No. of Trays	TBP 5% C	TBP 50% C	TBP 95% C	Flow kmoles/hr
Nafta		46							3242.00
Nafta		46							3776.23
Deviation									16.48 %
Kero	Y	31	33	194.45	6	157.00	193.40	223.50	737.00
Kero	Y	31	33	194.45	6	154.54	222.89	286.91	739.66
Deviation						1.56 %	15.25 %	28.37 %	0.36 %
AGO	Y	18	20	264.56	6	205.20	295.50	386.30	1884.00
AGO	Y	18	20	264.56	6	205.39	297.86	397.81	1884.21
Deviation						0.09 %	0.80 %	2.98 %	0.01 %
Residue		1		445.86		364.00	543.90	706.80	1741.00
Residue		1		445.86		362.66	534.83	615.52	1740.02
Deviation						0.37 %	1.67 %	12.91 %	0.06 %

Prediction Setup



Prediction Results



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Conclusion

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Key benefits and measurable outcome

- CDU is most energy intensive unit in refinery, hence optimizing the same is an area of interest.
- A refinery can reduce its transition time by 50% with frequent change in crude/crude blend.
- Robust model provides more time for analysis
- Increase of 2-3 % of most profitable product.

Conclusion

- Easy to implement, use and sustain business process
- Decision support aided with a latest tool – CDU.GOLD
- High ROI and attractive Payback

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Q & A

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Thank you

For More Information:

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