

Applexion
beyond purification

**American Society of
Sugar Beet Technologists**

Feb 27th 2025

Longbeach, CA

Antoine Charbonneau

Applexion footprint

>150 EMPLOYEES

>10% to R&D

 **Newark, DE - USA**
Process Development (IBRL, University of Illinois), Pilot, Sales office

 **Lyon – FR – Headquarter**
Process Development, Pilot, Engineering, Sales office

 **Shanghai - CH**
Process Development, Pilot, Engineering, Sales office

 **São Paulo - BR**
Process Development, Sales office, Local services

 **Tunis - TU**
Sales office, Local services,



 **Bangkok - TH**
Sales office, Local services, Process Development

 **Bangalore - IN**
Sales office, Local services

Annual Supply :

30 to 35 equipment installed
5 to 10 pilot units 6 to 8 revampings



16 patent families
76 patents



Differentiating purification technologies



Applexion
MEMBRANE FILTRATION



Applexion
CHROMATOGRAPHY



Applexion
ION EXCHANGE



+ A complete range of products and services for upstream & downstream operations

Catalysis, Enzymes
Electrodialysis, Active Carbon, Filtration
Evaporation, Crystallization, Drying





Our services throughout the lifetime of your equipment

Smart process solutions towards our customers' everyday industrial excellence



PROCESS & EQUIPMENT SUPPLY

- R&D
- Pilot
- System & Process line



DIGITAL & PERFORMANCE MANAGEMENT

- Digital services
- Consumables
- Spare parts



RE-ENGINEERING & REVAMPING SERVICES

- Non-stop operations
- Utilities savings (water, chemicals, energy)
- Columns & systems modernization



Applexion offer



PROCESS & EQUIPMENT SUPPLY

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The COVID-19 giant mess

After-Math in the industry

- Where have the operators gone?
- Where has the expertise gone ?
- Is my process unit running well ?
- Is my process unit running at its best ?
- Am I getting the most out of it ?



PERFORM 4.0: what is it about?

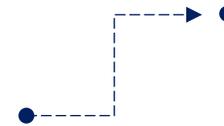
Improve performances with a digital solution



A proven proprietary Applexion R&D simulation software successfully **turned** into an industrial tool



Applexion separation **fine tuning** **expertise service** available on this easy-to-use web platform



A **guidance solution** to optimize purification process parameters



An efficient **«do better»** tool without any physical change to the unit

PERFORM 4.0: a learning digital twin

How does the digital twin work ?

- **Machine learning** software
- The **more you use it**, the **more accurate** it becomes !
- The tool is quickly **fully adapted** to your separation unit

Objectives:

- Achieve targets **quickly**
- **Immediately react** to an operational change by proposing new parameters



PERFORM 4.0: why using it?

Improve performances with a digital solution

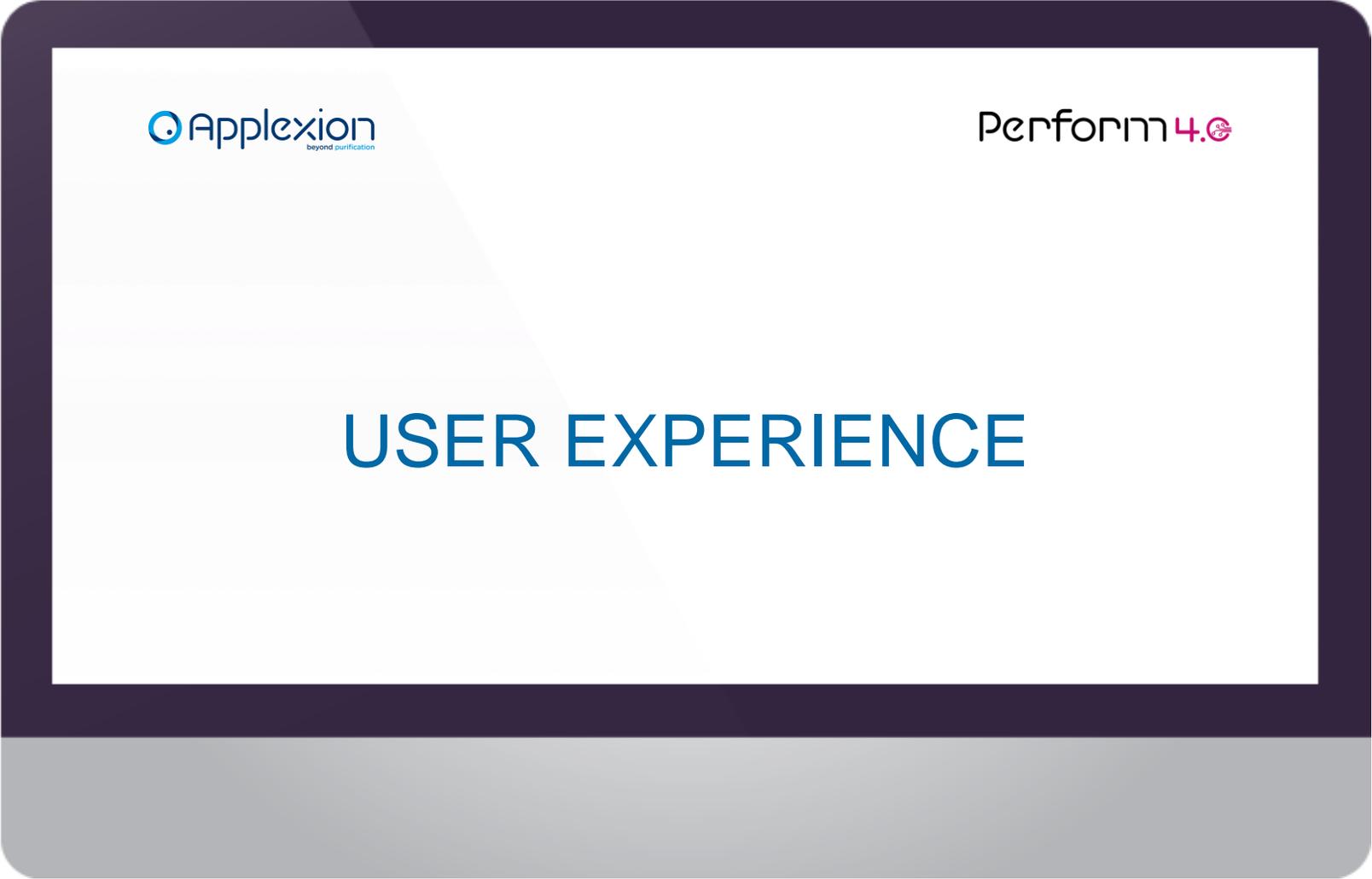


Developed to be your on-line “**Process Coach**” in purification process fine-tuning, whatever is your level of expertise

By your side to :

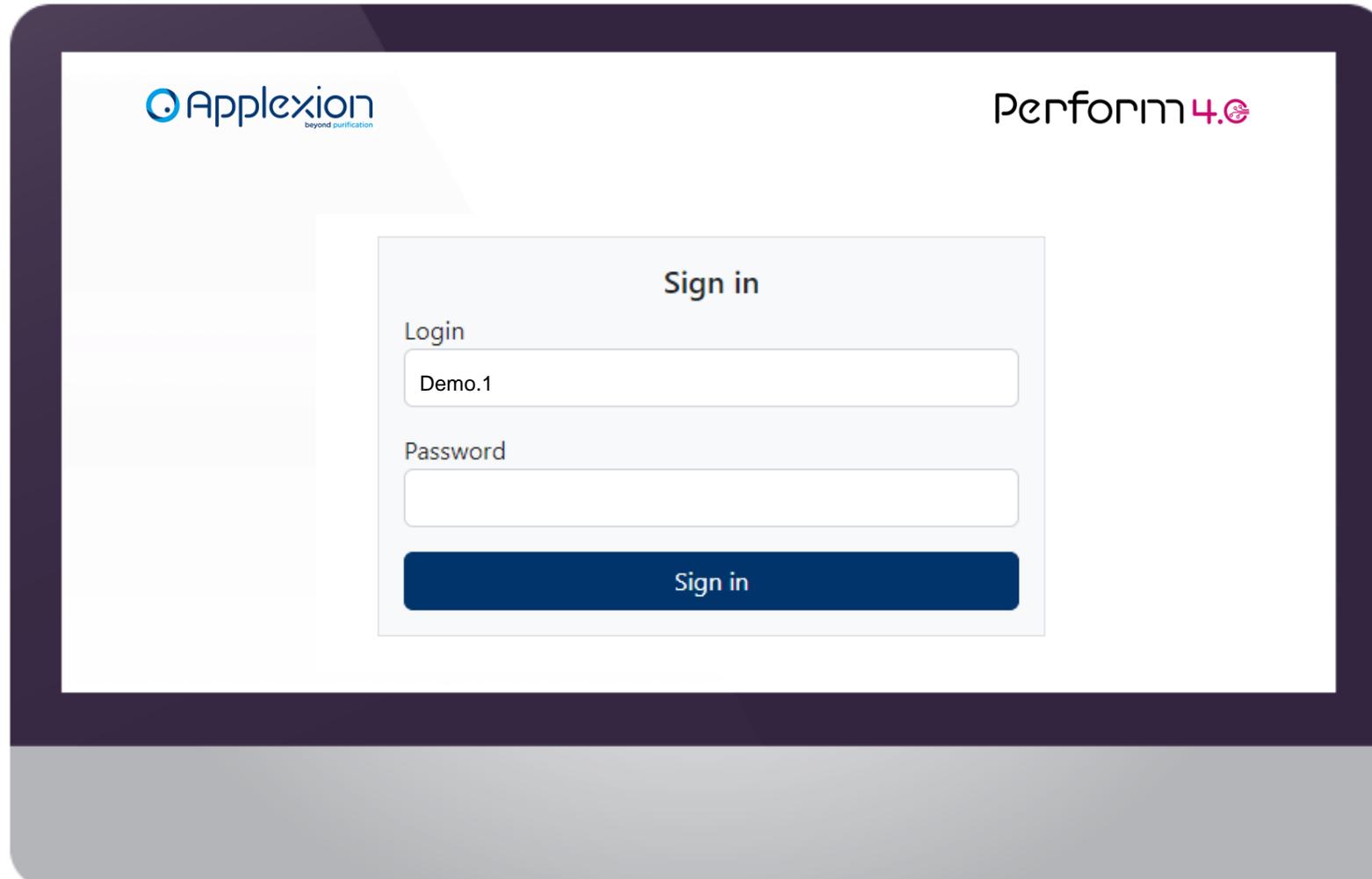
- **Reach** targeted separation performances (purity, recovery, impurity level ...)
- **Derisk** the setting choice and **reduce set-up times** by bringing more precision
- **Get the most** out of your equipment (optimize water consumption, feed injection ...)
- **Assist teams** by developing expertise, support them in decisions and **standardize** adjustment strategies

PERFORM 4.0: an easy-to-use platform



PERFORM 4.0: user experience

1 Login on the web platform



The screenshot shows a web browser window displaying the Applexion Perform 4.0 login interface. The Applexion logo is in the top left, and 'Perform 4.0' is in the top right. The main content is a 'Sign in' form with a title, a 'Login' field containing 'Demo.1', a 'Password' field, and a 'Sign in' button.

Applexion
beyond purification

Perform 4.0

Sign in

Login

Demo.1

Password

Sign in

**Demo version*

PERFORM 4.0: user experience

2 Upload your separation conditions and analyses

The screenshot displays the Applexion Perform 4.0 interface for 'Plant 2'. It includes sections for 'Process information', 'Process constraints', 'File uploads', and a chromatogram. A green arrow points to the 'New Run Data' button in the 'File uploads' section. Two callout boxes highlight key features: 'Upload a New set of data (sample analyses)' and 'Access to the previous uploaded files'.

Process information

Inner cell diameter:	60mm
Total cell height:	2,000mm

Process constraints

Priority	Type	Species	Fraction	Objective
1	Purity	A	To extract	> 99.45%
2	Yield	A	To extract	> 90%
3	Purity	B	To extract	< 0.8%

File uploads

Date	Cycle	File
12/19/22	204	chromato_204.xlsx
12/17/22	203	chromato_203.xlsx
12/12/22	202	chromato_202.xlsx
12/10/22	201	chromato_201.xlsx

Chromatogram

12/10/22 - chromato_201.xlsx

Project Zeus Plant Plant 1 Setting 11
Config 1 / 2 / 2 / 1
BV1 0.71 BV2 0.56 BVF 0.05 BV4 0.41

Concentration (g/L) vs Sequence (%)

Legend: A (blue), C (red)

Zone 4, Zone 3, Zone 2, Zone 1

*Demo version

PERFORM 4.0: user experience

2 Upload your separation conditions and analyses

The screenshot displays the Applexion Perform 4.0 interface for 'Plant 2'. It includes sections for process information, process constraints, file uploads, and a separation profile graph. A green arrow points to the top navigation bar, and two callout boxes highlight specific features.

Process information

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Total cell height:	2,000mm

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12/10/22 - chromato_201.xlsx

Project Zeus Plant Plant 1 Setting 11
Config 1 / 2 / 2 / 1
BV1 0.71 BV2 0.56 BVF 0.05 BV4 0.41

Separation profile display

The graph shows Concentration (g/L) on the y-axis (0 to 160) and Sequence (%) on the x-axis (-10 to 110). Two curves are shown: A (blue) and C (red). The profile is divided into four zones: Zone 4 (W), Zone 3 (R), Zone 2 (F), and Zone 1 (E). The concentration of species A peaks at approximately 60 g/L in Zone 2, while species C peaks at approximately 110 g/L in Zone 2.

*Demo version

PERFORM 4.0: user experience

3 Check model calculation

The screenshot displays the 'Model view' in the Applexion Perform 4.0 software. At the top, there is a navigation bar with 'Experimental Data', 'Model View', and 'Sensitivity Diagrams'. Below this is a table of data sets:

Date	Cycle	File	Current model	View	New model
12/19/22	204	chromato_204.xlsx	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12/17/22	203	chromato_203.xlsx	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12/12/22	202	chromato_202.xlsx	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12/10/22	201	chromato_201.xlsx	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

To the right of the table is a 'Train new model' button. Below the table are three precision diagrams, each showing 'Computed (g/L)' on the y-axis and 'Measured (g/L)' on the x-axis, both ranging from 8.5 to 17.5. Each diagram includes a blue diagonal line representing the ideal 1:1 relationship and data points for cycles 201, 202, 203, and 204. The diagrams are titled 'Purity Spe. A To extract', 'Yield Spe. A To extract', and 'Purity Spe. B To extract'. A green arrow points to the top of the interface, and a blue arrow points to the 'Train new model' button. Two callout boxes on the right provide instructions: 'Select the data sets to consider, Start the software calculation' and 'Precision diagrams views'.

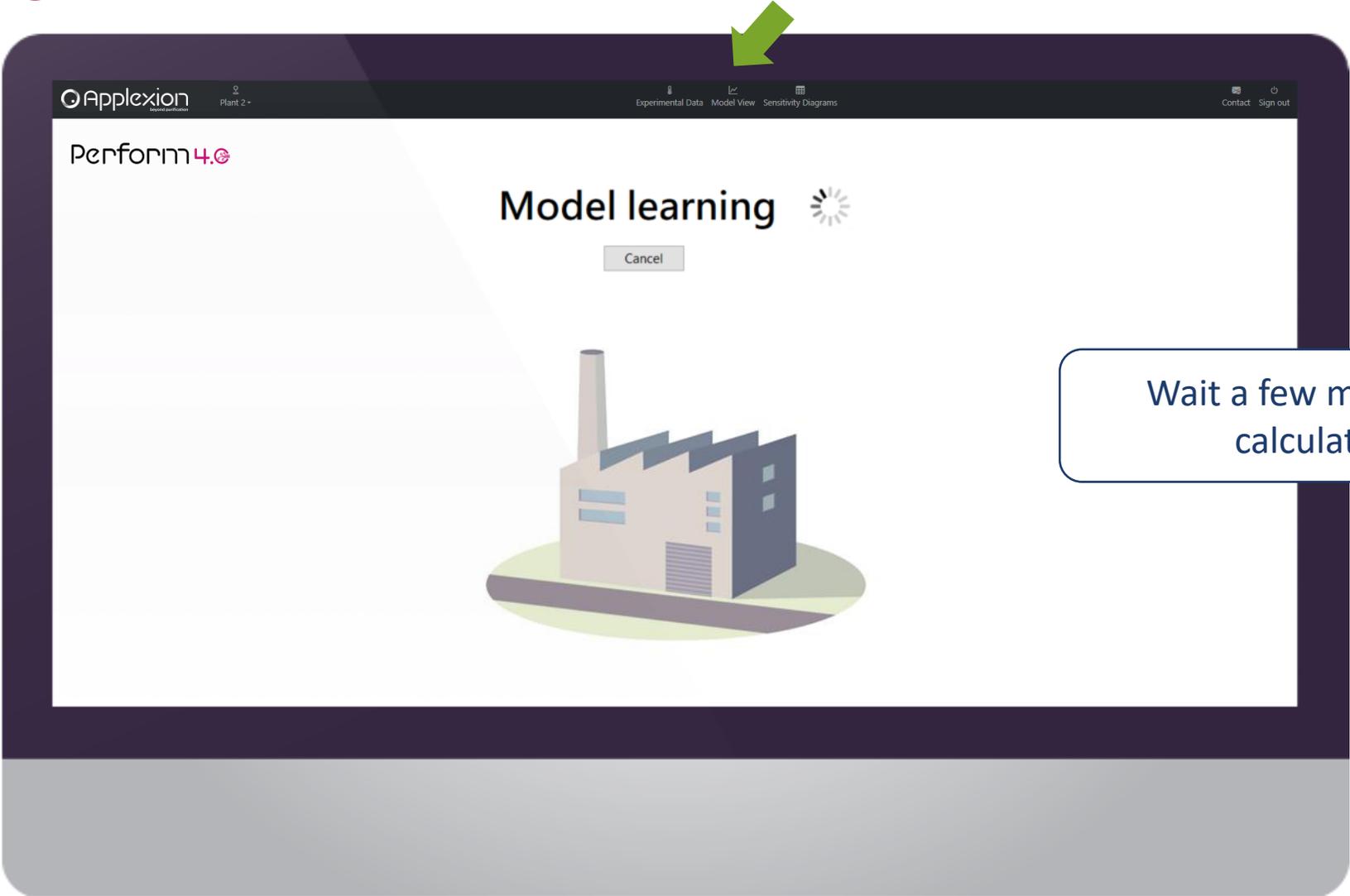
Select the data sets to consider, Start the software calculation

Precision diagrams views

*Demo version

PERFORM 4.0: user experience

3 Check model calculation

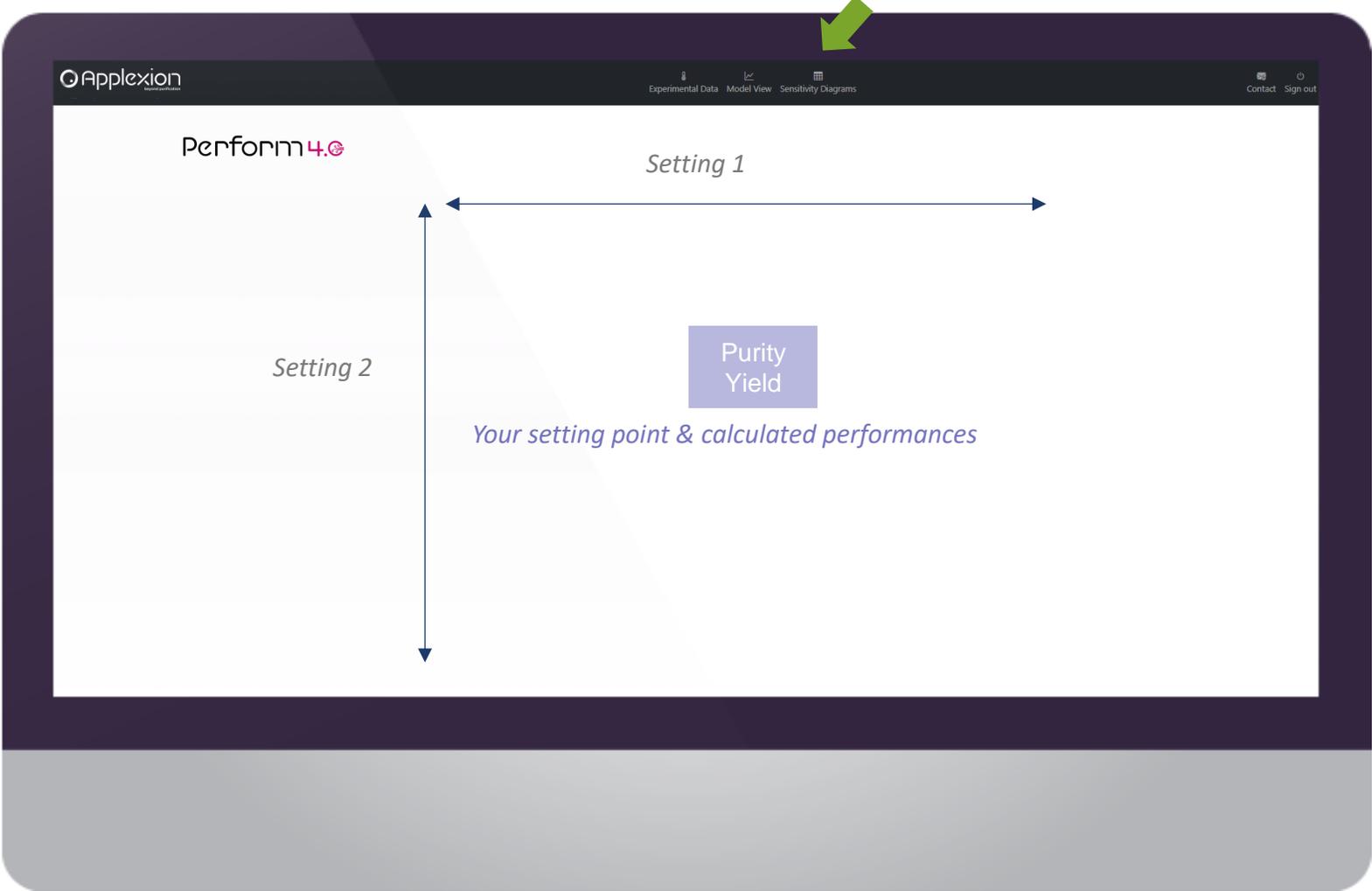


Wait a few minutes for calculations

**Demo version*

PERFORM 4.0: user experience

4 Get recommendations



*Demo version

PERFORM 4.0: user experience

4 Get recommendations

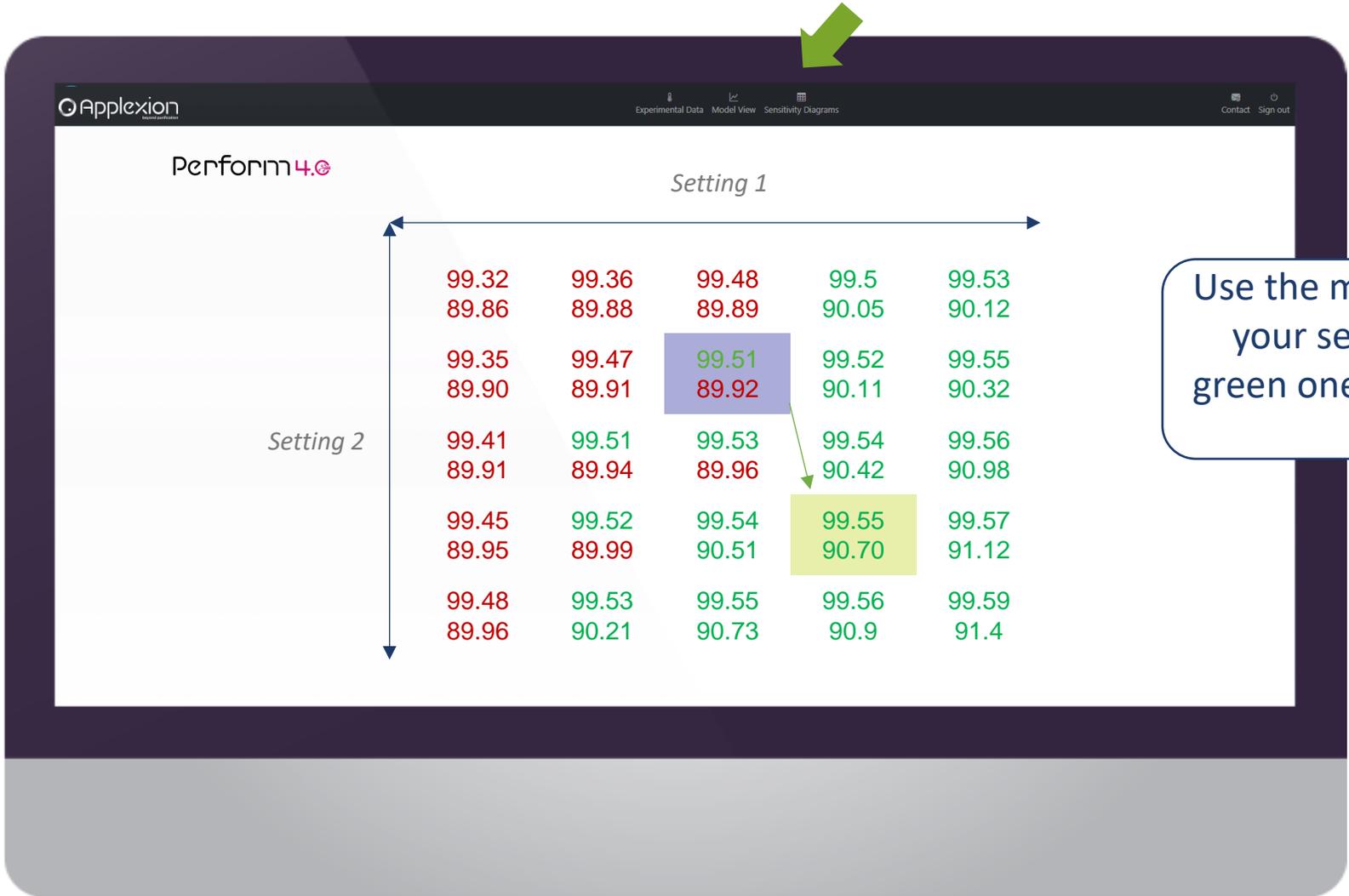
The screenshot shows the Applexion PERFORM 4.0 interface. At the top, there is a navigation bar with the Applexion logo and options for Experimental Data, Model View, Sensitivity Diagrams, Contact, and Sign out. The main content area displays a grid of data points for Purity and Yield under two settings: Setting 1 and Setting 2. A green arrow points to the top navigation bar. A callout box on the right contains the text: "Use the maps to move from your setting point to a green one, in line with your targets".

	Setting 1				
Setting 2	Purity	Purity	Purity	Purity	Purity
	Yield	Yield	Yield	Yield	Yield
	Purity	Purity	Purity	Purity	Purity
	Yield	Yield	Yield	Yield	Yield
	Purity	Purity	Purity	Purity	Purity
Yield	Yield	Yield	Yield	Yield	
Purity	Purity	Purity	Purity	Purity	
Yield	Yield	Yield	Yield	Yield	

*Demo version

PERFORM 4.0: user experience

5 Efficiently choose your new settings



*Demo version

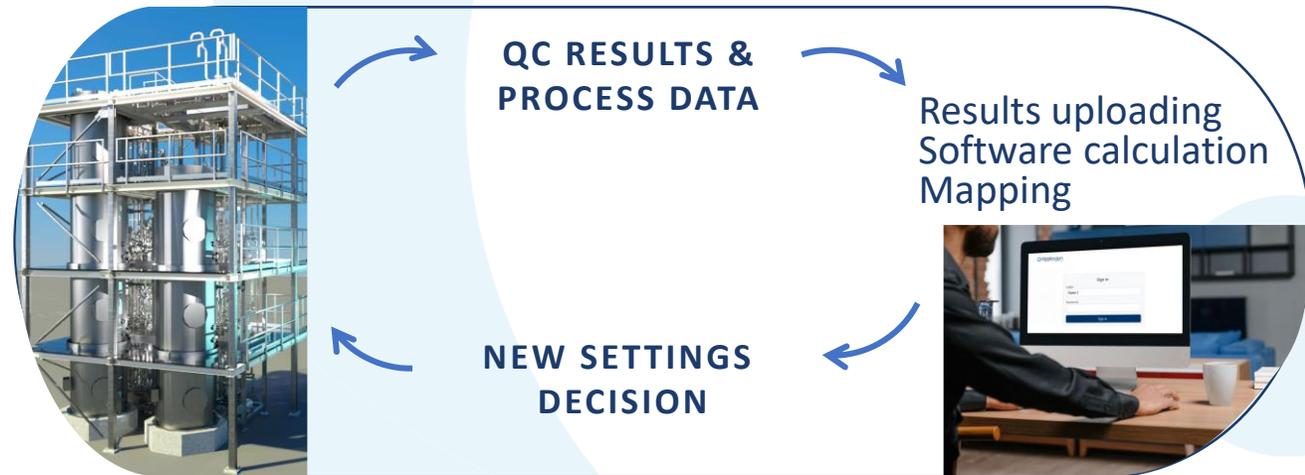
PERFORM 4.0: how do you use it?

Improving technologies with digital solution

Preliminary stage: define **your separation and performance targets** with Applexion

PERFORM 4.0 process:

- 1 Login on the web platform
- 2 Upload your separation conditions and analyses
- 3 Check model calculation
- 4 Get recommendation map
- 5 Efficiently choose your new settings
- 6 Modify the settings on your supervision



PERFORM 4.0: case study chromatography

Process optimization using PERFORM 4.0

Objective: increase recovery

Decrease of the performance observed onsite prior to PERFORM 4.0 use

Setting	1	...	4	5
Purity	>98%	...	>98%	>98%
Recovery	80%	...	88%	91%

↑
Performance
before using
PERFORM 4.0

➔ Only 5 shots !

Optimization:

- Increase of final product capacity
- No change in water consumption
- Decrease Energy consumptions (evaporation ↓)

Applexion™SC
6 cells
Sugars separation



PERFORM 4.0: case study chromatography

Process optimization using Run 4.0 & Perform 4.0

Applexion™SC
4 cells
Sugars separation



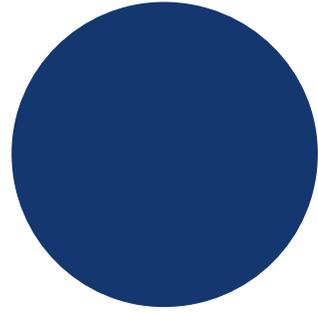
Starting point	t0	Before implementation of the digital services
Checkpoint	+ 1 year	After the implementation of the digital services

- ↑ Sugar recovery
- ↑ Dry matter in extract
- ↑ Feed injection quantity
- ↑ Injection speed

	Capacity In (tDS Feed/year In)	Sugar production (tDS/year)	Water to be evaporated	CO ₂ emissions /ton sugar produced	Operating Margin
Starting point	-	-	-	-	<10%
Checkpoint	+25%	+80%	-48%	-50%	16%

Applexion
RUN & PERFORM

RUN 4.0



RUN 4.0: main dashboard

General view



Main process unit information

Process unit status overview

Production monitoring



RUN 4.0: main dashboard

Process recommendations

Every Shift, a specific action plan



APPLEXION SC MONITORING
SEPARATION TYPE
PURITY TARGET : 90%
RECOVERY TARGET : 85%
RESIN :
APPLEXION SC SEQUENTIAL
BED VOLUME : 10L

CURRENT CONFIGURATION

TOTAL CELLS
6
ASC6C190D1, CYCLE COUNTER
51

BACK TO MAIN MENU



RECOMMENDATIONS LIST ON PREVIOUS SHIFT

Start	End	CONTRIBUTION RATE	RECOMMENDATION	SYMPTOM
2024-02-06 08:00	2024-02-06 14:00	44.80	Adapt boosters coefficients S2, on concerned zone, then on previous and next zone	Outlet pressure too high, 64 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 2, 3, 4, 5, 6], in cycles [48, 49]. Inlet pressure too high, 21 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 3, 4, 6], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00			Outlet pressure too low, 13 times, on cells [1, 2, 4, 5, 6], in periods [2, 3, 4, 5], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00	44.80	Adapt boosters coefficients S1, on concerned cell first, then on previous and next cell	Outlet pressure too high, 64 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 2, 3, 4, 5, 6], in cycles [48, 49]. Inlet pressure too high, 21 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 3, 4, 6], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00			Outlet pressure too low, 13 times, on cells [1, 2, 4, 5, 6], in periods [2, 3, 4, 5], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00	9.980	Check pressure distribution between cells	Outlet pressure too high, 64 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 2, 3, 4, 5, 6], in cycles [48, 49]. Inlet pressure too high, 21 times, on cells [1, 2, 3, 4, 5, 6], in periods [1, 3, 4, 6], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00			Outlet pressure too low, 13 times, on cells [1, 2, 4, 5, 6], in periods [2, 3, 4, 5], in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00	0.4300	Make sure unit was stable with last analysis, and make new BV settings after taking a profile with Perform 4.0	Too low purity of total targeted species in raffinate, 2 times, in cycles [48, 49].
2024-02-06 08:00	2024-02-06 14:00	0.0200	Check feed quality (dry substance concentration, suspended solids, temperature)	Too low purity of total targeted species in raffinate, 2 times, in cycles [48, 49].

Priority goes to

Action to be taken

Reason for the action



Digital tools





THANK YOU



PERFORM 4.0: implementation steps

Working with Applexion

	Applexion scope	You
Remote installation <ul style="list-style-type: none">• Remote preparation• Development of the digital twin• Configuration of the calculation platform• Online Trainings	<ul style="list-style-type: none">✓✓✓✓	separation information sharing may require feed & resin samples - Participation

 Ready to start using the software

Digital guidance solution to optimize purification process parameters

Available on a web platform

Perform 4.0

Enjoy shorter time to reach your performance objectives.
Get the most out of your equipment.

Optimal product quality

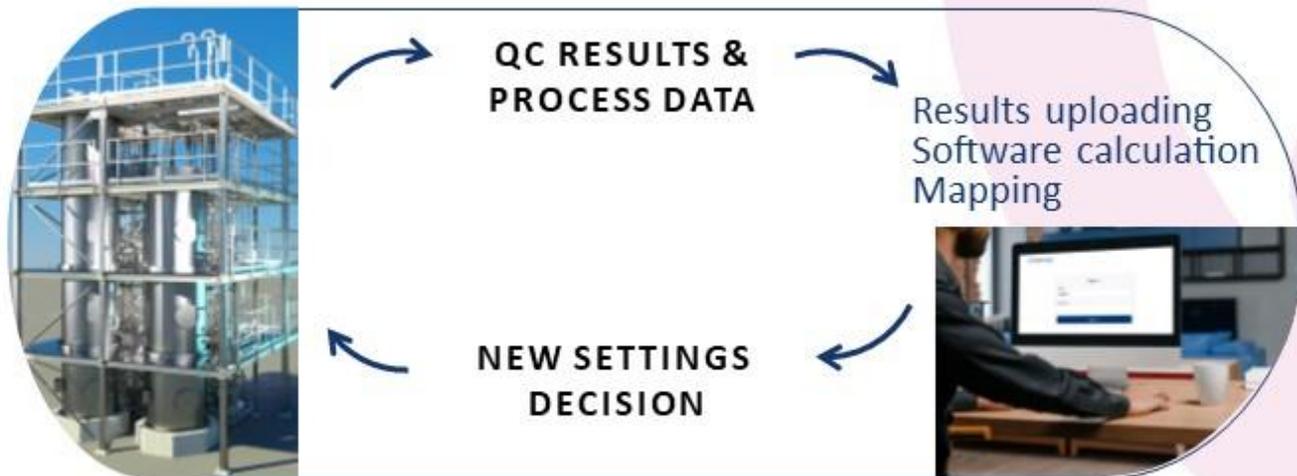
Easy to use

Reliability of settings

Time saving

Operational excellence

Gain in adjustment precision



Based on a unique and reliable Applexion proprietary Machine learning software and your performance initial targets

- 1 Enter your production parameters and separation analyses
- 2 Get recommendation to efficiently choose your new settings

Daily digital solution to better operate the purification process

Available on a web platform

RUN 4.0

Get a quick and helpful view of the mechanical state of your process.
Provide process monitoring, alerts, identification & recommendations.

Process under supervision

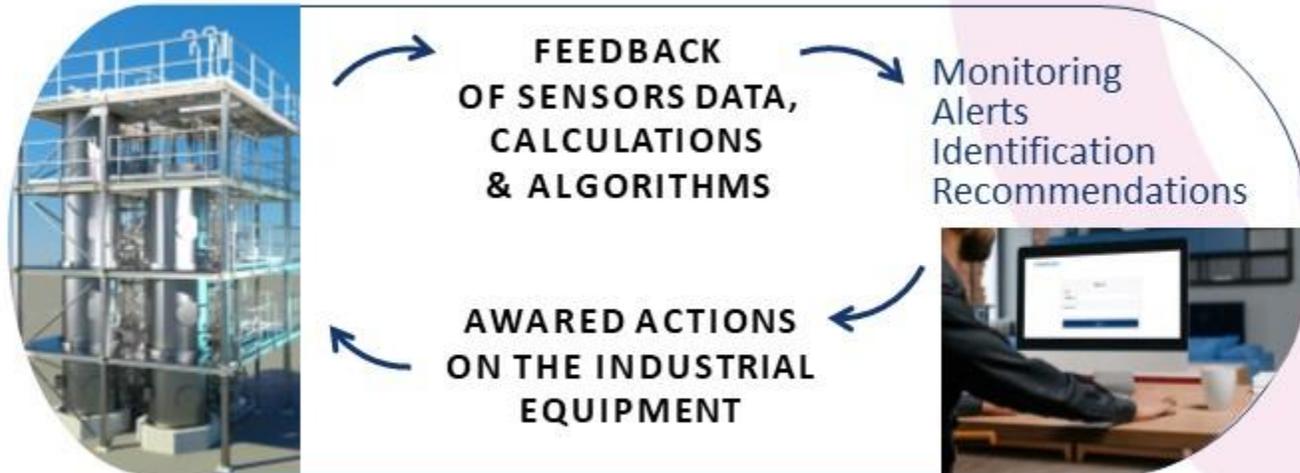
Easy to use

Readability

Structured information

Peace of mind

Easier problem solving



Focus on mechanics & hydraulics of industrial equipment

- 1 Monitor your purification system
- 2 Be alerted when deviation occurs
- 3 Get recommendations to identify & solve the issue