A LINQX Company

WHITE PAPER

Standardizing Cement Lab Workflows:

Real-Time Collaboration for Slurry Accuracy

CONTENTS

I. Introduction

The meticulous design and testing of cement slurries are pivotal aspects of every cementing operation. Yet, the inherent variability between wells can render this process arduous and costly. Traditionally, engineers and lab technicians grappled with paper files, while the advent of spreadsheet software like Excel® provided a leap in reporting efficiency. However, the challenge of organizing and searching through numerous reports persisted.

Without an interactive cement lab database, professionals faced numerous hurdles:

1. Challenges in designing cement slurries.
2. Redundant resource expenditure on repetitive tests.
3. Inability to validate design flaws during operational issues.
4. Difficulty in maintaining consistent standards across multiple labs.
5. Extra workload associated with transferring designs and testing data.
6. Struggles in tracking both ongoing and completed design tests.

II. Software Solution

In response to fractured processes, manual data entry, and disconnected labs, Pegasus Vertex — a LINQX company—has developed CEMLab, a next-gen web-based application that unifies and streamlines every aspect of cement lab operations:

1. Web-Based Lab Efficiency:
   CEMLab's web-based platform enables seamless access to critical functionalities from any location, facilitating real-time collaboration and decision-making.

2. Centralized Database for Multiple Labs:
   Manage multiple labs effortlessly with a centralized database, ensuring consistency and coherence across the organization.

3. Integration with Azure Active Directory:
   With single sign-on and role-based permissions, CEMLab simplifies user management while ensuring secure, compliant access for administrators, designers, and technicians.

4. Multi-User Online Collaboration:
   Foster multi-user collaboration with online collaboration tools, enabling swift communication and task management.

5. Automated Slurry Formulation:
   CEMLab provides sophisticated tools for designing and calculating formulations, covering lead and tail slurry, spacer, and wash formulations. Its flexible workflow allows for seamless refinement and iteration.

6. Expanded Testing Capabilities:
   Conduct a comprehensive range of 16 tests—standard and user-defined—empowering users to tailor tests to specific project requirements.

7. Instant Data Search and Retrieval:
   Utilize advanced search functionalities to swiftly retrieve relevant data based on various combined criteria, enhancing data analysis and decision-making.

8. Comprehensive Master Material Database:
   Access a comprehensive repository of materials for precise formulation and costing, ensuring accuracy and consistency.

9. Real-Time Task Allocation and Job Tracking:
   Track job progress effortlessly with due date checking and job tracking functionalities, enabling timely completion of tasks.

10. Lab Data Analysis:
    Harness powerful data analysis tools to derive actionable insights from lab data, facilitating informed decision-making.

11. Equipment Database and Calibration Monitoring:
    Maintain an organized equipment database with calibration tracking, ensuring accurate and reliable test results.

12. Density/Porosity Input:
    Define slurry density and porosity with ease, providing flexibility in formulation design.

13. Comprehensive Reporting:
    Generate detailed Excel® reports including test sheets, full reports, summaries, and cost reports for comprehensive analysis and documentation.

14. Remote Test Request and Review Submissions:
    Technicians can submit test data and results from any location, designers can review and iterate in real time, and the platform maintains a full audit trail of every request, adjustment, and approval.

15. Automated Notifications:
    Receive timely email notifications for important updates and milestones, ensuring efficient communication within teams.

16. Lot Number, Mixing Order, and History Log:
    Keep track of essential details such as lot numbers, mixing orders, and history logs for comprehensive traceability and accountability.

17. Cost Calculation and Super Sack:
    Calculate the cost of cement slurries accurately and efficiently, with the added functionality of super sack calculations for large-scale operations.

18. Admin-Level Lab and User Management:
    Admins can configure lab-wide protocols, test templates, and user permissions—ensuring that only authorized personnel can finalize designs or alter master data.

By bringing these features together into a single, cloud-native platform, CEMLab delivers unprecedented efficiency, consistency, and control—empowering cementing engineers, lab managers, and QA/QC teams to focus on quality rather than paperwork.

III. Program Structure

CEMLab is tailored to cater to various user roles within the system. The program flowchart, as illustrated in Fig. 1, delineates the involvement of administrators, slurry specialists, and lab technicians.

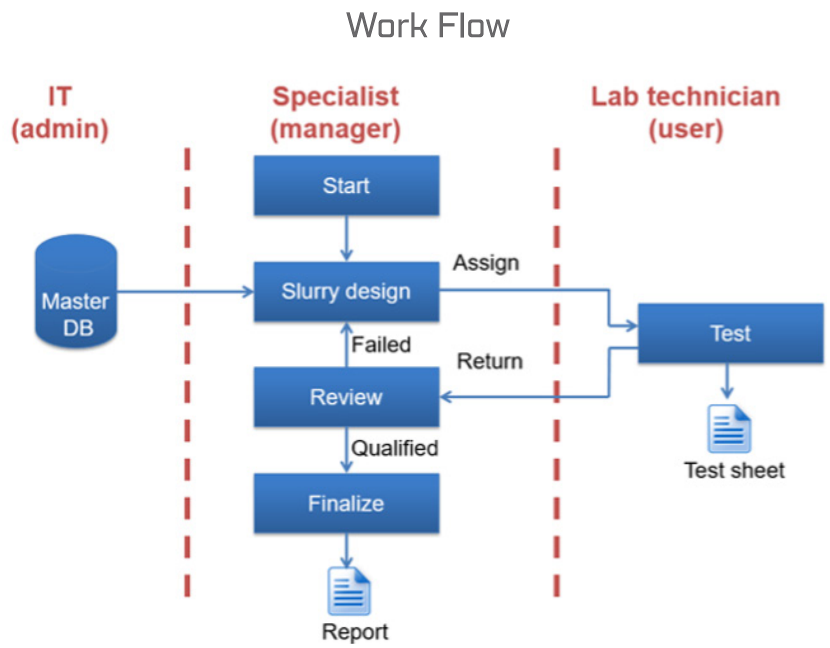


Figure 1: Work flowchart

The administrator, holding the highest privilege, oversees the master database comprising crucial information on cement, chemical additives, and base fluids, including codes, specific gravity (SG), bulk density, and prices. Upon logging into CEMLab, general users leverage this database to formulate cement slurries. Once a slurry design is finalized, users can generate a test or weigh-up sheet and assign the task to another lab technician, specifying the required tests. The designated technician then follows the slurry formula, conducts the tests, and records the results in CEMLab. Upon completion, the results are submitted for review by the original designer. If satisfied, the designer finalizes the slurry design and generates a final report. Otherwise, adjustments are made to the design, and subsequent test requests are initiated. This iterative process continues until a qualified slurry design is achieved.

IV. Intuitive User Interface

CEMLab features a user-friendly interface designed to streamline key tasks, including design, search, master database access, and management. The Job Tracking section, as illustrated in Fig. 2, offers a clear overview of the fluid design and testing process, categorizing tasks into four stages:

1. **Designing**: This stage includes fluid designs currently undergoing development.
2. **Testing**: Fluid designs assigned for testing to either specific users or entire labs.
3. **Reviewing**: Completed fluid design tests awaiting review by the original designer.
4. **Finalized**: Completed fluid designs archived for future reference and retrieval.

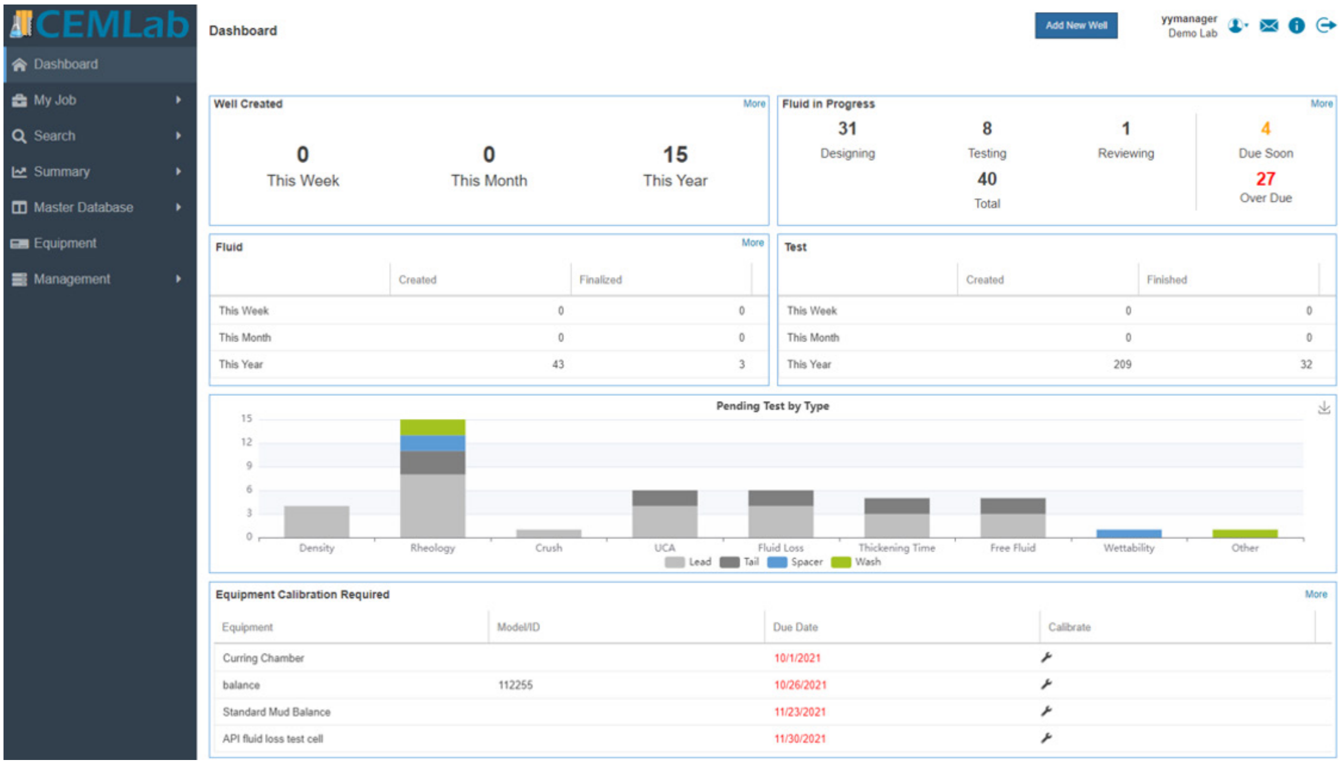


Figure 2: User Interface

V. Streamlined Slurry Design

In the slurry design module of CEMLab, users have access to various sections, including blend, solid additive, liquid additive, and base fluid to facilitate their slurry formulation process (Fig. 3).

Figure 3: Blend

This is complemented by a dynamic interface that provides a summary of slurry parameters and calculated results, enhancing user efficiency and decision-making (Fig. 4).

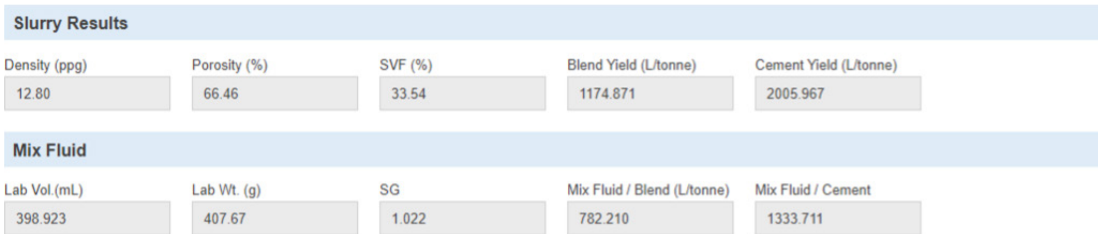


Figure 4: Slurry Property and Results

Users can initiate their cement slurry design by specifying either the desired slurry density or porosity, offering flexibility in the formulation process. CEMLab accommodates diverse unit preferences, allowing users to input ingredient concentrations in %BWOC, %BWOB, %BVOB, %BWOW, lb/sk, and gal/sk, tailoring the experience to individual needs. Moreover, users can define the volume of slurry samples, with the option to adjust it as required, ensuring adaptability to specific project demands.

The cost calculation functionalities within CEMLab enable users to estimate the expenses associated with their cement slurry formulation based on ingredient unit prices. Additionally, the 'super sack' feature facilitates bulk quantity calculations, aiding in efficient resource planning and cost estimation. This comprehensive suite of tools is further enhanced by collaborative features such as comments and attachments sections, enabling seamless communication and documentation within the platform.

VI. Efficient Testing

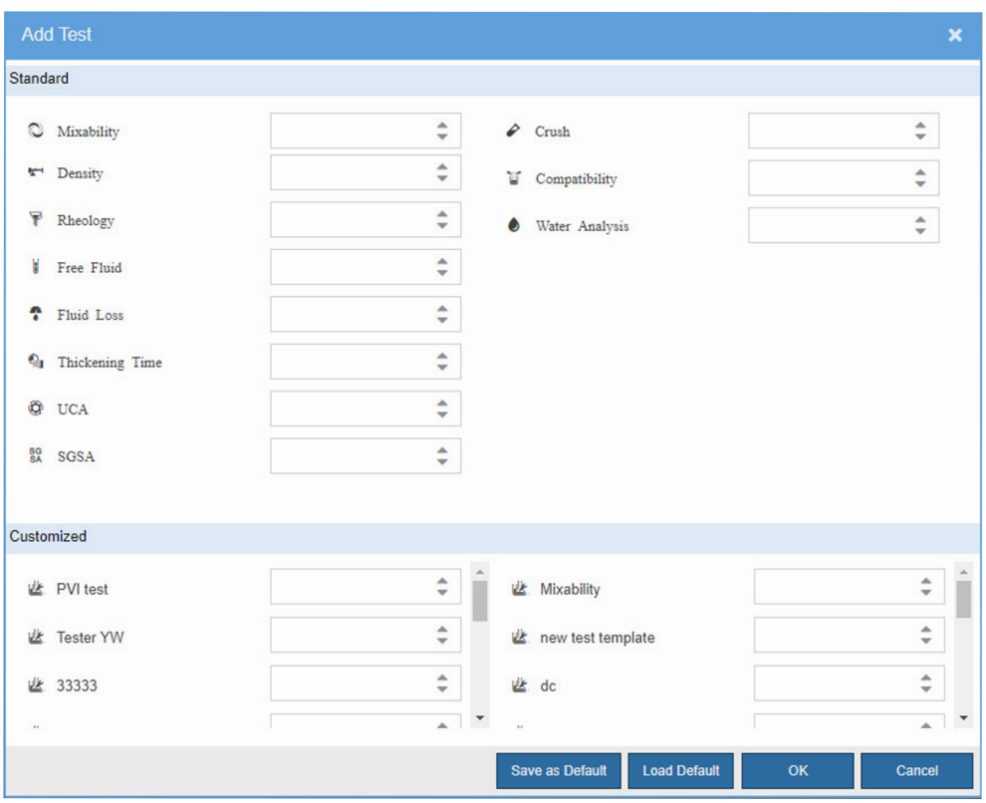


Figure 5: Tests

The user could add different types of tests in one place. For example, in the Rheology window, users can input viscometer readings, allowing the system to calculate and display results (Fig. 6). Additionally, it generates a shear rate vs. shear stress graph, offering insights into fluid behavior. The system supports three rheological models: Bingham plastic, Power law, and Herschel Bulkley.

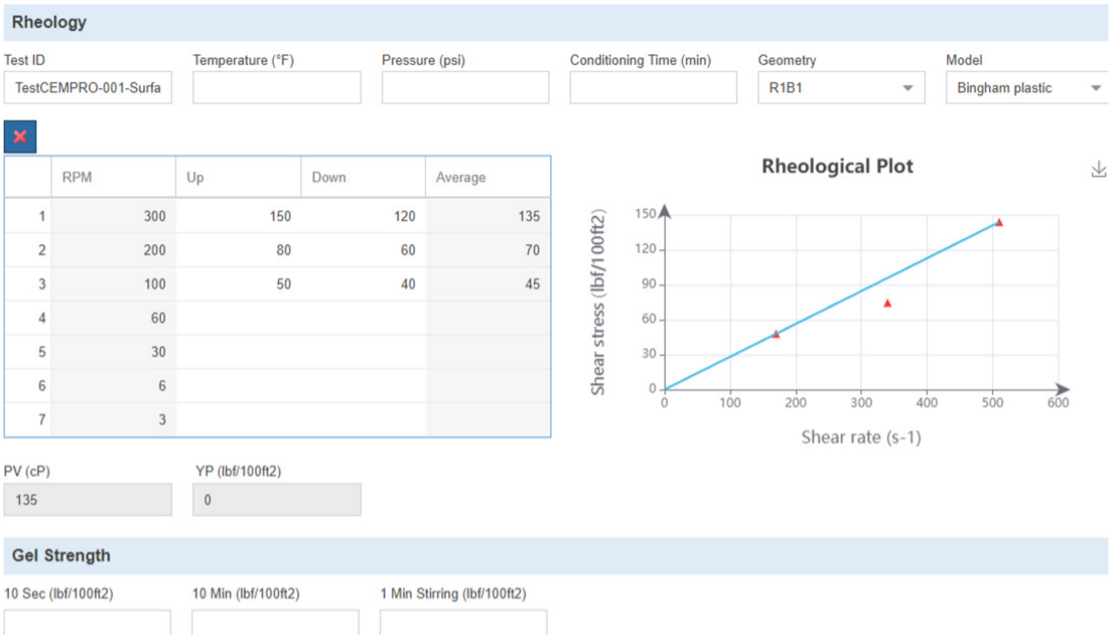


Figure 6: Rheology Test

Furthermore, the Crush test is pivotal in laboratory settings. Users can navigate to the Compressive Strength page, where they input initial and final temperatures and pressures (see Fig. 7). Here, users await input of test results. Additionally, a picture box below permits users to upload images captured by testing devices. All data, including results and images, is compiled into the final report, ensuring comprehensive documentation of test outcomes.

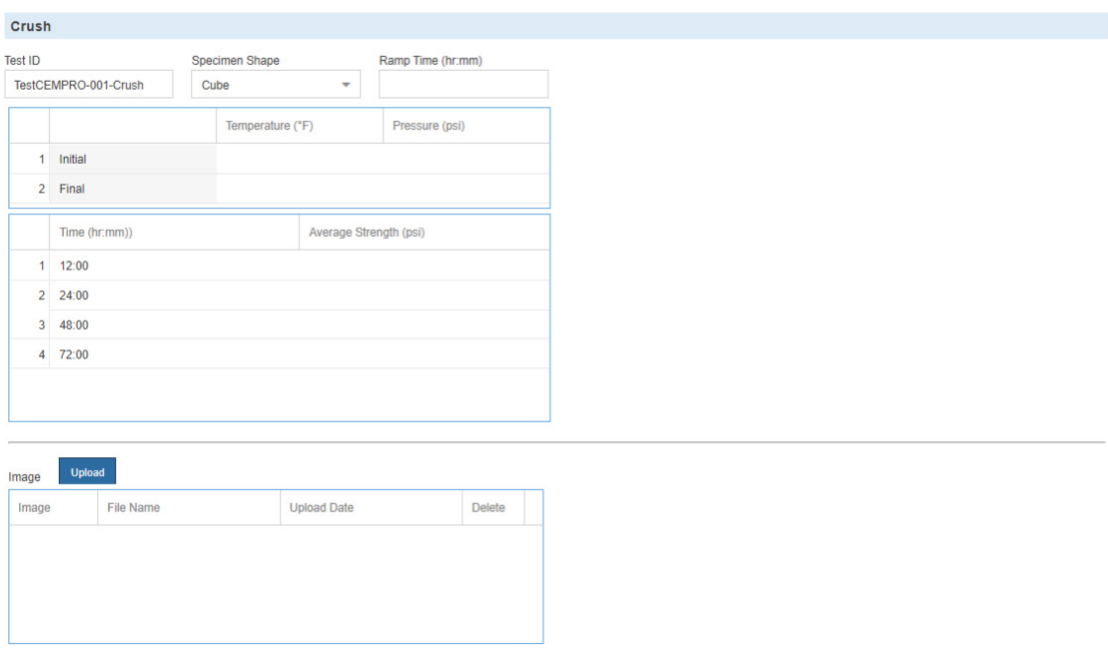


Figure 7: Crush Test

VII. Advanced Search

The search functionality, both Well and Fluid, empowers users to swiftly locate desired wells and formulas and previously conducted tests.

Users can input keywords to search for one or multiple slurry designs or set specific numerical limits for parameters such as slurry density. For instance, they can search within a range of values or filter by specific ingredient codes. Additionally, users can leverage the advanced search feature to input desired test results, further refining their search.

The more detailed the search criteria, the more precise the search results become (Fig. 8). For example, users can narrow down their search to specific time frames, geographical locations, or even by specific additives. This allows users to pinpoint relevant data quickly and effectively.

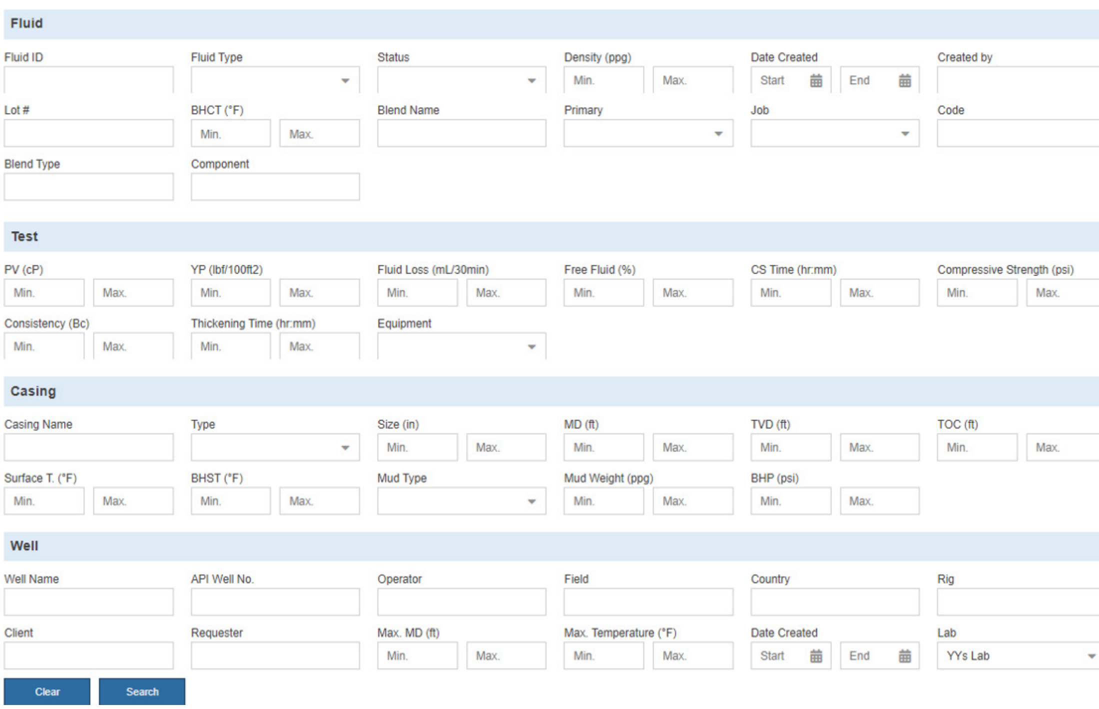
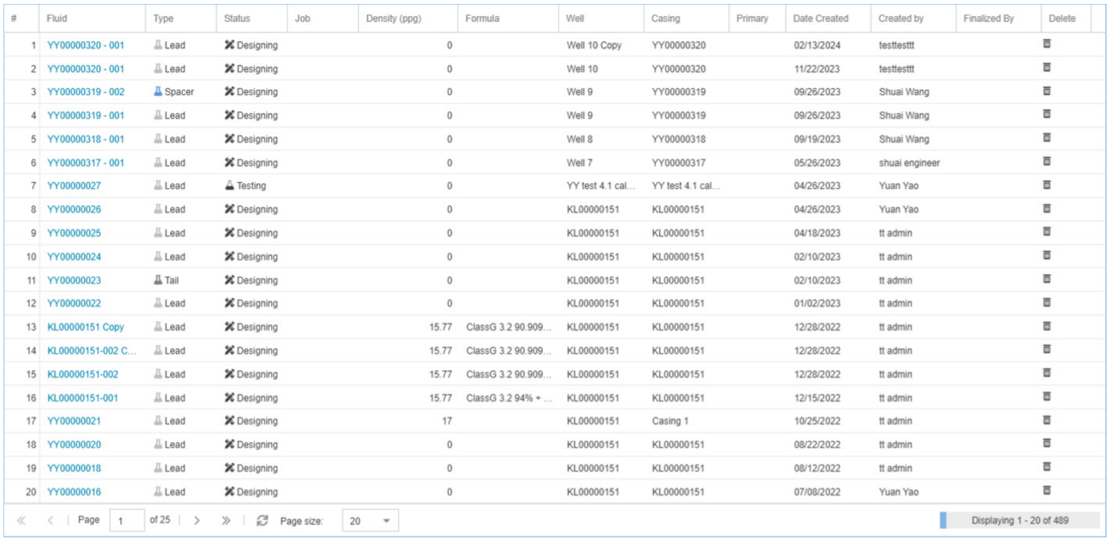


Figure 8: Search Function

Once the search is executed, all matching criteria are presented on the Search Results page (Fig. 9). In cases where numerous results are displayed, users can easily navigate through the list by sorting the data based on their preferences, ensuring efficient access to the desired information.



#	Fluid	Type	Status	Job	Density (ppg)	Formula	Well	Casing	Primary	Date Created	Created by	Finalized By	Delete
1	YY00000320 - 001	Lead	Designing		0		Well 10 Copy	YY00000320		02/13/2024	testtesttt		
2	YY00000320 - 001	Lead	Designing		0		Well 10	YY00000320		11/22/2023	testtesttt		
3	YY00000319 - 002	Spacer	Designing		0		Well 9	YY00000319		09/26/2023	Shuai Wang		
4	YY00000319 - 001	Lead	Designing		0		Well 9	YY00000319		09/26/2023	Shuai Wang		
5	YY00000318 - 001	Lead	Designing		0		Well 8	YY00000318		09/19/2023	Shuai Wang		
6	YY00000317 - 001	Lead	Designing		0		Well 7	YY00000317		05/26/2023	shuai engineer		
7	YY00000027	Lead	Testing		0		YY test 4.1 cal...	YY test 4.1 cal...		04/26/2023	Yuan Yao		
8	YY00000026	Lead	Designing		0		KL00000151	KL00000151		04/26/2023	Yuan Yao		
9	YY00000025	Lead	Designing		0		KL00000151	KL00000151		04/18/2023	tt admin		
10	YY00000024	Lead	Designing		0		KL00000151	KL00000151		02/10/2023	tt admin		
11	YY00000023	Tail	Designing		0		KL00000151	KL00000151		02/10/2023	tt admin		
12	YY00000022	Lead	Designing		0		KL00000151	KL00000151		01/02/2023	tt admin		
13	KL00000151 Copy	Lead	Designing		15.77	ClassG 3.2 90.909...	KL00000151	KL00000151		12/28/2022	tt admin		
14	KL00000151-002 C...	Lead	Designing		15.77	ClassG 3.2 90.909...	KL00000151	KL00000151		12/28/2022	tt admin		
15	KL00000151-002	Lead	Designing		15.77	ClassG 3.2 90.909...	KL00000151	KL00000151		12/28/2022	tt admin		
16	KL00000151-001	Lead	Designing		15.77	ClassG 3.2 94% + ...	KL00000151	KL00000151		12/15/2022	tt admin		
17	YY00000021	Lead	Designing		17		KL00000151	Casing 1		10/25/2022	tt admin		
18	YY00000020	Lead	Designing		0		KL00000151	KL00000151		08/22/2022	tt admin		
19	YY00000018	Lead	Designing		0		KL00000151	KL00000151		08/12/2022	tt admin		
20	YY00000016	Lead	Designing		0		KL00000151	KL00000151		07/08/2022	Yuan Yao		

Page 1 of 25 | Page size: 20 | Displaying 1 - 20 of 489

Figure 9: Search Results

VIII. Slurry Summary

The summary section helps to analyze historical data from your lab in the form of charts and graphs. It includes the finished and ongoing Well, Fluid, and Test results (Fig. 10–12). Users could specify the filter criteria to locate certain data ranges.

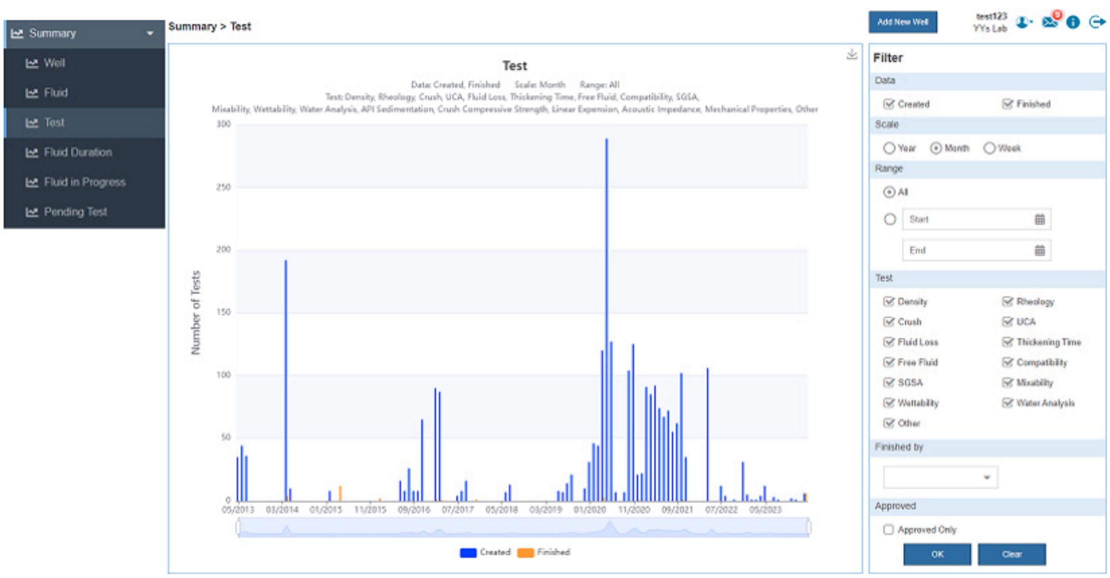


Figure 10: Finished Test

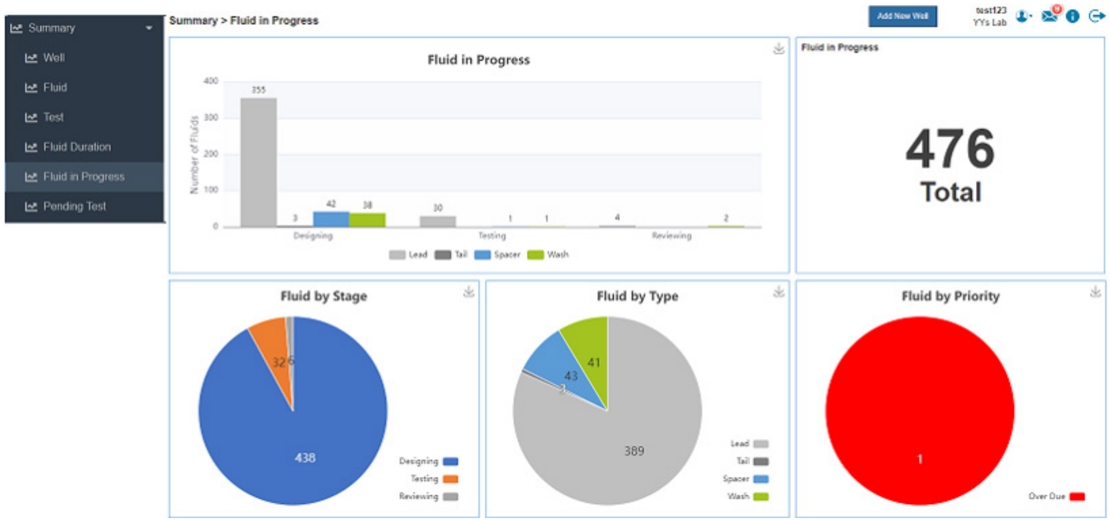


Figure 11: Fluid in Progress

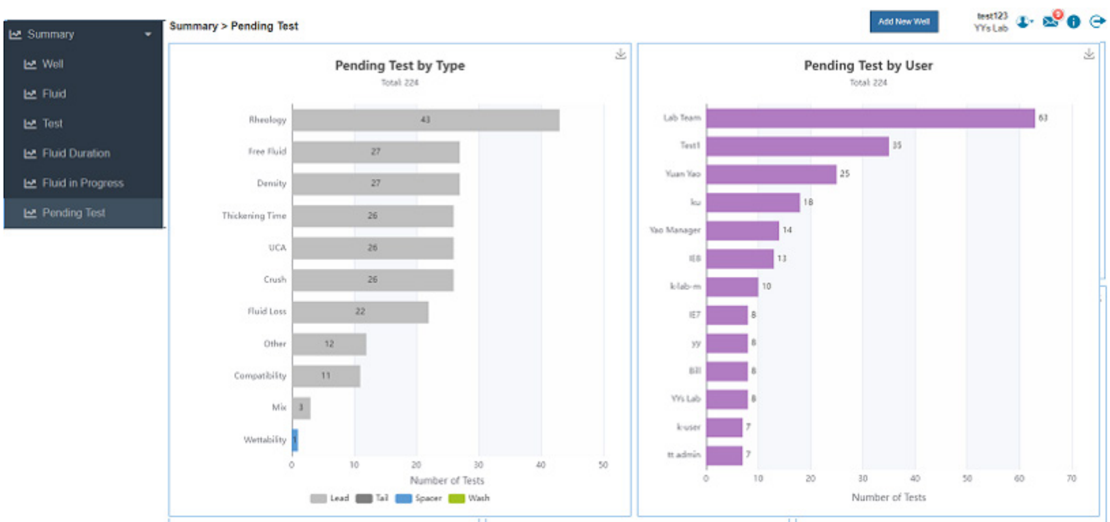


Figure 12: Pending Test

IX. Reporting Capabilities

CEMLab offers versatile reporting options, including a test sheet, full report, and summary report for each case.

The test sheet provides lab technicians with detailed cement slurry formulas for accurate mixing, accompanied by blank tables to record test results efficiently (see Fig. 13).

Report No. TestCEMPRO-001
CEMLab Test Sheet
PVI Test Lab

Well Information

Well	Pegasus No. 1	Client	Big Find	Country	USA	Requestor	
Rig	TEST Rig	Operator	Operator 1	Bulk Plant		Reviewer	

Job Information

Casing	TestCEMPRO	Job		Shoe MD (m)		Shoe TVD (m)	
Type		Date	3/15/2018	BHST (°C)		BHCT (°C)	
Size (mm)		Mud		MW (kg/m3)	1198.3	BHP (kPa)	

Slurry Properties

Density (kg/m3)	Cement Yield (L/tonne)	Blend Yield (L/tonne)	Porosity (%)	SVF (%)	Water Salinity (kg/m3)	Mix Fluid (L/tonne)	Solid Component SG
1533.8	2005.967	1174.871	66.46	33.54		782.21	2.549

Slurry Composition **Mixed Fluid Wt. 407.67g** **Total Blend Wt. 509.99g**

Order	Code	SG	Component	Concentration	Unit	Lab Vol. (mL)	Lab Wt. (g)	Mode	Lot #
1	ClsG	3.22	G	58.649	%BWOB		299.11	Dry	
2	BuckPOz	2.46	Buckeye Type c	30	%BWOB		153	Dry	
3	EMFL	1.22	polytrol	10	%BWOC		29.91	Dry	
4	EMFL3070	1.402	FL34+CFL235	10	%BVOB		27.98	Dry	
5	C030	2.65	Silica flour	0.1	%BWOB		0.51	Wet	
6	C080	0.9	PP Fiber	0.2	%BWOC		0.6	Dry	
7	C104	2.4	MT Retarder Synthetic	0.3	lb/sk		2.05	Dry	
8	C011	1	Antifoam	10	L/Tonne	5.1	5.1	Wet	
9	C061	1.4	MicroBlock	2	L/Tonne	1.02	1.43	Wet	
10	NaCl		NaCl	3	%BWOW		11.67	Dry	
11	Water	1	Fresh water	762.672	L/tonne	388.959	388.96	Wet	

Density - TestCEMPRO-001-Density

Temperature (°C)		Pressure (kPa)		Density (kg/m3)	
Comments					
Equipment		Signature		Date	

Rheology - TestCEMPRO-001-Surface Rheology

T. (°C)	P. (kPa)	Conditioning Time (min)		300	200	100	60	30	6	3	Gel Str. (Pa)		
			Up	150.00	80.00	50.00					10 Sec	10 Min	1 Min Stirring
			Down	120.00	60.00	40.00							
Comments													
Equipment							Signature				Date		

Free Fluid - TestCEMPRO-001-FF

Conditioning T. (°C)	Conditioning Time (min)	Static 2 hr T. (°C)	Inclination (deg)	Initial Volume (mL)	Free Fluid (mL)	Setting
						No
Comments						
Equipment			Signature		Date	

Figure 13: Test Sheet

CEMENT LAB REPORT

Client	Big Find	**Rig**	Test Rig	**Operator**	Operator 1
Date	15-Mar-18	**Well**	Pegasus Well	**Fluid ID Number**	TestCEMPRO-001

Well Data

Mud Weight	1198.3 kg/m3	**Job Type**		**BHP**	1000 kPa
Depth MD	2000 m	**BHCT**	80°C	**TRB**	
Depth TVD	1500m	**BHST**	85 °C	**T. Gradient**	5 °C/100m

Composition

Mix Fluid Required	782.21	L/tonne	**Mix Water Required**	762.672	L/tonne
Slurry Yield	1174.871	L/tonne	**Measured Density**	1533.8	kg/m3

Code	Description	Concentration	Unit	Lot Number
C011	Antifoam	10	L/Tonne	
ClsG	G	58.649	%BWOB	
Water	Fresh water			
BuckPOz	Buckeye Type c	30	%BWOB	
C030	Silica flour	0.1	%BWOB	
NaCl		3	%BWOW	

Rheology Data

Rheometric Measurements	Temperature	Rheology at	deg °C		Rheology at	deg °C	
	Fann (rpm)	Up	Down	Avg	Up	Down	Avg
Rheometer Type	300	150	120	135			
Bingham plastic	200	80	60	70			
	100	50	40	45			
Geometry	60						
R1B1	30						
	6						
		PV (cP)		135	PV (cP)		
		YP (Pa)		0	YP (lbf/100ft2)		
	Gel Strength	10 sec	10 min	Gel Strength	10 sec	10 min	

Rheo Tested By:

Thickening Time	
Consistency	**Time (H:M)**
50 Bc	1:11
70 Bc	2:22

TT Tested By:

Free Fluid mL	deg	45 deg

FF Tested By:

Atmospheric Consistometer Reading		
0 min	**5 min**	**20 min**
UCA Strength (kPa)	**12 hrs (kPa)**	**24 hrs (kPa)**
	7660	15320

UCA Tested By:

Fluid Loss (Static)	
Test Temp (°C)	
Collected Fluid (mL)	
Collection Time (min)	30
API Fluid Loss (mL/30min)	

FL Tested By:

Water Analysis	
Salinity (kg/m3)	
Hardness (kg/m3)	
Water Density (kg/m3)	
pH	

Water Analysis Tested By:

Mixing Time (sec.)	

Checked Mixing Time By:

Comments		**Required TT:**

Figure 14: Final Report

Meanwhile, the final report serves as a comprehensive summary of the entire slurry job (see Fig. 14). It encompasses the slurry formula, test results, pertinent graphs, and if relevant, the super sack sheet, providing stakeholders with a holistic overview of the project's outcomes.

X. Conclusion

CEMLab represents a paradigm shift in cement lab data management, empowering professionals to achieve globally consistent slurry/spacer formulations and enhance cementing techniques. With its advanced features and intuitive interface, CEMLab revolutionizes cement lab operations, ensuring efficiency, accuracy, and reliability across multiple labs worldwide.

Ready to see how CEMLab in action? Book a personalized demo today and discover how you can centralize your data, automate slurry design, and collaborate in real time—transforming your cement lab for peak efficiency and accuracy.

Try Free Trial—Streamline Your Lab Workflows Today!

A LINQX Company
6100 Corporate Dr., Ste 448, Houston, TX 77036, USA
(713)981-5558 sales@pvisoftware.com www.pvisoftware.com

Schedule Demo