

1. BJSP CEMENT SERVICES: ENGINEERING SUPPORT

A staff of experienced engineers and laboratory technicians based in Hassi Messaoud supports BJSP cement operations. Equipment and purpose-built facilities for all routine cement testing are available on site. Tests are performed to current industry standards (API) or can be modified to suit individual client or operational requirements. BJSP operates a quality management system. All engineering and laboratory support services are provided in accordance with the QMS.

Further levels of engineering and laboratory support are available from BJ Services' Europe & Africa Region Technology Centre in Aberdeen and the worldwide R&D facility in Tomball, Texas. As a joint venture between BJ Services and ENSP, BJSP has complete and unrestricted access to all BJ Services' technology.

1.1 LABORATORY SERVICES

The lab in Hassi Messaoud is fully equipped to perform all routine cement tests:

- Thickening time
- Determination of rheological properties
- Fluid loss
- Free water
- Compressive strength - by UCA method or by cubes
- Fluid compatibility tests (mud/spacer/cement)

The following table shows the main items of cement test equipment.

Description	Quantity
Constant speed mixer	1
Atmospheric consistometer	3
Fann 35 rheometer	4
HPHT consistometer (25,000psi/200°C)	4
Hydraulic press	1
HPHT curing chamber (3,500psi/380°C)	1
UCA cell (20,000psi/200°C)	3
HPHT filter press	3
Portable consistometer (Newsco model PC10)	2

In addition the laboratory can provide water analysis services. A variety of properties can be tested including pH, salinity, chloride content and hardness.

Where required for remote locations, BJSP can provide laboratory services to enable cement testing in the field.

1.2 ENGINEERING SERVICES

A team of qualified and experienced engineers is available 24/7 to meet client requirements. The engineering team works closely with the client and BJSP operations personnel to ensure a smooth transition from program design to execution.

1.3 Cement Programs

Cement programs are produced in a standard format that includes both metric and oilfield units. This allows field personnel to work in the system they are familiar with. Programs are written in English or French as required. The standard program format can be tailored to suit individual client requirements. Programs are prepared in Microsoft Excel[®] format to enable access without the need for proprietary software.

The standard program contains the following details:

- Wellbore diagram and capacities
- Fluid volume calculations
- Displacement calculations
- Hydrostatic pressures
- Slurry/spacer designs
- Pump schedule
- Laboratory test report

1.4 Engineering Software

As an aid to cement program design two BJ Services' software packages are used extensively - **CMFACTS[™]** and **WellTemp[™]**.

CMFACTS is used primarily to simulate the pumping operation and calculate circulating densities and pressures. It can be used as a stand-alone package to prepare complete cementing programs. CMFACTS can also be used to design centraliser spacing programs.

CMFACTS features include:

- Total flexibility of unit conventions
- Hole, casing and deviation data modules
- Foam cement module
- Centraliser module with centraliser database
- Drag & torque calculations for casing running
- Pore & frac pressure calculations
- Fluids database
- Calculation of fluid flow model from input data
- Simulation of circulating pressures & densities
- Inventory module
- Laboratory test report

The centraliser module calculates stand-off along the well bore from input data such as directional survey data, fluid densities (internal and external) and centraliser type. Centraliser data - restoring forces, diameter, etc. - can be selected from a database of all centralisers currently available from all manufacturers. Alternatively, the data can be entered manually.

The software can process up to 5 different intervals allowing standoff or centraliser type to be varied along the wellbore.

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The software can be used in 2 modes. A minimum standoff is user-specified and the required spacing is calculated. Alternatively, spacing is specified and the minimum standoff is calculated. Data can be output in graphic or tabulated form.

CMFACTS may also be used in real time to calculate downhole pressures and circulating densities during the cement job. CMFACTS is compatible with all BJ Services' data acquisition systems: **3305 Mini Monitor**; **3600 Treatment Monitor**; **Isoplex** and **Wireless LAN**. Additionally, data recorded during the job can be used to model downhole pressures for post-job analysis and process improvement.

WellTemp software is used to calculate downhole circulating temperatures essential to successful cement program design. The sophisticated algorithms within the WellTemp software use a number of parameters when calculating circulating temperatures:

- BHST & depth
- Circulating rate & time
- Fluid properties - density, rheology, heat conductivity
- Heat transfer properties of casing and formation
- Flow direction-normal or reverse circulation modes & circulation through inner string or CT

The WellTemp package has a number of useful features:

- Graphic and tabulated output of results
- Calculation of temperature along the entire wellbore - inside pipe and annulus
- Calculation of "hot spots"

1.5 Data Acquisition Systems

All BJSP pump units are fitted with the BJ Services **3305 Mini Monitor**. The 3305 is used to display and record up to 7 data channels during pumping operations. The unit has an integral LCD display to view data but can be linked to external and/or remote displays.

Features of the 3305 are:

- 7 data channels - 3 flow, 2 pressure, 2 density
- Integral thermal paper chart recorder - ideal for pressure test records
- Data stored in solid state memory - data cassette

The removable data cassettes are used to store and transfer job data. The stored data can be used by a number of proprietary software packages for post-job analysis (e.g. **CMFACTS**). Alternatively, the data is converted to ASCII format for import to spreadsheet and graphics software.

1.6 Operations Reports

It is BJSP policy to prepare a post-job report for all cement operations. Each report contains details of the equipment used, fluid designs and volumes and pumping rates. Fluid rates, densities and pump pressures are presented graphically.

The post-job reports are collated into an end-of-well report providing the client with a concise history of cement operations for each well.

2. BJSP CEMENT SERVICES: EQUIPMENT & PRODUCTS

2.1 CEMENT UNITS

BJSP currently has a fleet of 19 cement units:

- 15 6x6 truck-mounted twin-pump units with BJ Services' precision slurry mixer (PSM) mixing system
- 2 Truck-mounted single pump
- 1 skid-mounted twin-pump PSM unit
- 1 trailer-mounted twin-pump unit with BJ Services' recirculating averaging mixer (RAM) mixing system and automatic cement control (ACC)

All units are fitted with BJ Services' *Pacemaker™* triplex pumps, DBIV electronic densimeter and 3305 Mini Monitor for data acquisition.

Specification	118 PSM 6x6 Truck Unit	138C PSM 6x6 Truck Unit	40-75-2 PSM Skid Unit	35-8-5 RAM Trailer Unit
Road engine	Detroit Diesel 6V92TA	Caterpillar 3406C	N/A	N/A
Rated horsepower	350 BHP @ 2100 rpm	490 BHP @ 2100 rpm	N/A	N/A
Deck engine	Detroit Diesel 8V71N	Caterpillar 3406C	900 BHP DC Traction	Detroit Diesel 8V71 (2)
Rated horsepower	670 BHP (335 BHP each)	980 BHP (490 BHP each)	1100 BHP	670 BHP (335 BHP each)
Triplex pumps	BJ Pacemaker (2)	BJ Pacemaker (2)	BJ Pacemaker (2)	BJ Pacemaker (2)
Mixing pumps	BJ Centrifugal (2)	BJ Centrifugal (2)	BJ Centrifugal (2)	BJ Centrifugal (2)
Recirculating pump	Morris 4JC14	Morris 4JC14	Morris 4JC14	Morris 4JC14
Displacement tank capacity	36 bbl	36 bbl	20 bbl (2 x 10bbl)	20 bbl (2 x 10bbl)
Mixing tank capacity	2 bbl	2 bbl	2 bbl	25 bbl
Maximum working pressure	15,000 psi (3.5" plungers)	15,000 psi (3.5" plungers)	15,000 psi (3.5" plungers)	15,000 psi (3.5" plungers)
Maximum flow rate	20 bbl/min (5" plungers)	20 bbl/min (5" plungers)	20 bbl/min (5" plungers)	20 bbl/min (5" plungers)

All units are capable of mixing and displacing slurries at rates up to 10 bpm (1.59 m³/min) depending on slurry density and densities up to 22 ppg (2.64 kg/l).

PSM units have a secondary mixing system (jet mixer & supercharger) as back-up

2.2 CEMENT STORAGE & HANDLING

Cement operations are supported by the bulk storage plants in Hassi Messaoud and Hassi R'Mel. Cement is stored, blended and discharged into road transports for transfer to the wellsite. Wellsite storage is in 60T pressurised cement silos. All bulk cement is transferred pneumatically to minimise exposure to dust.

For very remote locations with poor accessibility, cutting bottles can be provided to enable cement to be cut on site.

2.3 BATCH TANKS & BATCH MIXERS

A range of skid-mounted batch tanks and trailer-mounted batch mixers are available for mixing cement slurry, weighted spacer, preflush and mix water on site. Typically, batch tanks remain on location for the duration of the well. Batch mixers are moved to location as required.

Batch Tank Specifications

- 50m³ capacity
- 2 compartments (25/25 or 35/15)
- Paddles for agitation
- Centrifugal pumps for recirculation
- Integral jet mixer

Batch Mixer Specifications

- 8, 16 & 24m³ capacities
- 2 compartments
- Paddles or augers for agitation
- Centrifugal pumps for recirculation

Additionally, a range of open and closed tanks is available for storage of water, brine, etc.

2.4 EXAMPLE LOCATION RIG-UP



From L → R

- 20m³ water tank (open top)
- 50m³ batch tank
- 20m³ water tank (closed)
- 138PSM cement unit
- Surge can
- Dust collector
- 60T silo



2.5 CEMENT HEADS

BJSP use BJ Services' *Fas-Lok* cement heads. The unique *Fas-Lok* design requires only a 30° rotation to effect a secure coupling between the cement head and landing joint.

Landing joints are available for all commonly used casing sizes and thread types.

Circulating heads, single plug and double plug heads are available for all commonly used casing sizes.

2.6 DOWNHOLE TOOLS

A range of service tools is available for all cementing and pressure testing applications.

Retrievable Packers

Retrievable packers for pressure testing and isolation are available for all grades and weights of 7", 9-5/8" and 13-3/8" casing

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Bridge Plugs & Cement Retainers

Bridge plugs and cement retainers for isolation and remedial and squeeze cement operations are available for all grades and weights of 4-1/2", 7", 9-5/8" and 13-3/8" casing.

Setting tools for drill pipe and wireline are available.

Retreivable Bridge Plugs

Retreivable bridge plugs for isolation are available for all grades and weights of 4-1/2", 7", 9-5/8" and 13-3/8" casing.

Parabow Cementing Tool

BJ Services' patented *Parabow* cementing tool provides a cost-effective solution for the placement of cement plugs in cased, open and deviated hole sections.

The *Parabow* tool provides a solid barrier to support the cement thus eliminating the problems that can be encountered when setting balanced plugs.

Parabow is a combined running and cementing tool. The *Parabow* consists of a retrievable tool that can be run on drill pipe or CT and an expendable insert. When set, the insert provides a barrier to fluid flow in both directions. The *Parabow* insert can be set and cement pumped in a single run, thereby reducing operating time. The lightweight construction of the insert ensures it is readily drillable with all types of bit.

2.7 CEMENT AND ADDITIVES

API Class G Portland Cement is used for most primary and remedial cement operations. Two types of Class G are available:

Asland API Class G HSR

Dyckerhoff API Class G HSR

Other cement types are available on request.

For intervals with higher temperature Class G/silica flour blends are available.

Speciality Cements

Ultrafine Cement

Ultrafine cement, a blend of Portland Cement and ground granulated blastfurnace slag (GGBS), for squeeze and remedial applications.

MagnePlus Cement

MagnePlus is a unique acid-soluble cement system. It is particularly suited to the temporary abandonment of production intervals. It has non-damaging filtrate and is readily removed by the use of hydrochloric or organic acid.

MagnePlus can also be used to cure losses while drilling. Its' particle size distribution makes it an ideal bridging agent, it can be pumped through the bit/BHA thereby reducing operating time, and is readily drillable when set.

Cement Additives

BJSP uses BJ Service Company's range of cement additives. A full range of products is available to cover all requirements for cementing operations in Algeria.

Product	Description
A-2	Sodium metasilicate cement extender. Dry additive.
A-3L	Sodium silicate solution cement extender/accelerator.
BA-56	BJ Hybrid combined polymer fluid loss & bonding agent. Dry additive.
BA-58L	Microsilica suspension bonding agent.
BA-86L	Liquid latex polymer bonding & gas control agent.
BJ Thixo	Liquid thixotropic agent.
Calcium Chloride	Cement accelerator. Dry additive.
CD-32	Cement dispersant. Dry additive.
CD-33L	Non-retarding liquid cement dispersant. Suitable for salt slurries.
D-42L	Liquid anti-foam agent.
FL-32L	Liquid fluid loss control agent. For moderate-high temperatures and salt slurries.
FL-50	Fluid loss additive for extended slurries. Dry additive.
GW-22	Gelling agent for weighted spacers.
GW-28	Gelling agent for weighted spacers.
LW-6	Microspheres - HECS cement extender.
MCS-B	Mud clean surfactant.
R-12L	Low-moderate temperature cement retarder.
R-15L	High temperature cement retarder.
W-10	Weighting agent.

Additionally, commodity items such as salt, haematite, KCl, bentonite and barite can be supplied on request.

***BJSP-Lite* HECS Cement System**

BJSP-Lite is a high, early compressive strength (HECS) lightweight cement system. Slurry densities as low as 1.25 kg/l (10.4 ppg) are achievable. Compressive strength values are in excess of those obtained with conventional extended slurries.

The unique mixing procedure for *BJSP-Lite* ensures consistent slurry density throughout the job and improved CBL response. All additives, including LW-6 lightweight additive, are added directly to the mix water on location. The slurry is then mixed on-the-fly.

There is no problem with blend segregation during transit and no requirement to blend cement or store different blends/cements on location.

W-10 Weighting Agent

W-10 weighting agent has a density of 4.8 kg/l, comparable to that of haematite. Unlike haematite, there is no requirement to dry blend the weighting agent with the cement.

The fine, uniform particle size of W-10 allows it to be added directly to the mix water on location without settling problems. The slurry can then be batch mixed or mixed on-the-fly.

The particle size distribution allows easier mixing with none of the rheology problems encountered with haematite. The reduced viscosity means greater achievable slurry density, greater pump rates, reduced ECD values, better mud removal and improved CBL results.

Spacers & Washes

A range of chemical wash, preflush and weighted spacer fluids is available to aid mud removal, prevent cement contamination and improve cement bond to both pipe and formation.

Lost Circulation Material

BJSP has a number of options available to prevent and cure lost circulation.

Bridging agents such as cellophane, BJ Fibres (polypropylene fibres) that can be added to conventional cement slurries.

Thixotropic agents such as BJ Thixo, a liquid cement additive, or thixotropic cement slurries designed with bentonite and/or gypsum.

MagnePlus and ultrafine speciality cement systems.

Flowguard liquid lost circulation material that can be pumped by itself or as a cement preflush.