



JORDAN PHOSPHATE MINES COMPANY ESHIDIYA WELLFIELD 21 WELL REHABILITATION PROJECT



It's not magic. You'll just think it is.

INTRODUCTION

California-based WellJet recently teamed up with Jordanian partner KAC (Khost Aqua Consulting) to rehabilitate the 21 wells supplying the Eshadiya facility for JPMC (Jordan Phosphate Mines Company).

This project is part of WellJet's global growth initiative, beginning with the waterchallenged environments of the Middle East-North Africa region, and expanding worldwide.

BACKGROUND

Phosphate, used in agriculture and industry around the world, is one of leading exports of the Hashemite Kingdom of Jordan, providing the nation's treasury with much-needed foreign trade income.



JPMC Operations and Facilities

Large quantities of water are required to recover phosphate, via slurry that is processed to separate the mineral from sand and clay in the matrix.

JPMC, Jordan's only phosphate mining company, operates three mines – Russeifa, Hassa and Eshidiya.

The Eshidiya mine is located in southern Jordan, east of Al Jafr, in the Ma'an Governate. And it is here, to this remote desert, that WellJet/KAC deployed – to perform its patented rehabilitation process on the wells that provide water to the mine.



The wells had been drilled in 1991. Total depths ranged from 234-288m (767-945'). Static water levels ranged from 69-113m (226-371'). When new, the wells produced 50-150 m3/hr (220-660 gpm). By the time of rehabilitation, flow rates had fallen so low that even the most productive well (#18) had dropped to 100 m3/hr (440 gpm). Static water levels had declined to 72-119m (236-390').

As flow rates and efficiency plummeted, various rehabilitation efforts were made, but recovery never regained original performance levels.

The wells, in operation for 25 years, exhibited a declining flow rate and efficiency profile consistent with the industry-accepted generic profile shown at right:



WRD Technical Bulletin (Specific Capacity), Ted Johnson

Since the Eshidiya facility requires water from at least 14 wells to keep operating, WellJet/KAC began by rehabilitating 7 wells that were currently out of service for various reasons – including foreign objects that had become lodged downhole:



Some of these foreign objects were fished out by KAC. For those that could not be fished out, WellJet (US Patent No. 8,312,930) high-pressure waterjetting tools were utilized to pulverize.

REHABILITATION PROCESS

Once the obstacles were cleared, jetting began. WellJet utilizes highly pressurized water in a laminar flow to remove encrustation inside the well casing, open plugged perforations, and penetrate into the gravel pack to break up harmful deposits that impede water flow. Jetting starts at the bottom of the perforated area, and continues throughout the production zone to ensure that 100% of perfs are jetted.





WellJet operations at JPMC Eshidiya wellfield







JPMC personnel observe high-pressure jetting from behind safety barrier

Jetting was followed by dual-swab surge-blocking and airlifting, to remove fill that came in from the jetting process. It was not unusual to see up to 40m (131') of material dislodged by jetting.





Because WellJet generates such tremendous energy out beyond the well screen into the gravel pack and near-wellbore formation, proper surging after jetting is essential to pull dislodged deposits into the well, from which they can be evacuated.



In the Eshidiya wells, the fill was typically a mixture of drill mud, fine sand, and iron scale:



Downhole video was recorded to provide Before/After visual comparison:









+0190.0M



Before/After video shows how WellJet removed obstructions and opened plugged perforations.

Following rehabilitation, test pumping was conducted to measure results. To enable a direct Before-and-After comparison, the exact same pump equipment, calibration and specifications were utilized and followed as prior to the rehabilitation:



At first, 20 minutes of black water...

Then clear.



The next day, just 3 minutes of black water...

Then clear.





WellJet inventor Jeff Glass and KAC partner Mansour Khost examine flowmeter results.



RESULTS

When these 21 wells were drilled in 1991, their flow rates ranged from a low of 50 m3/hr (220 gpm) [Well #4] to a high of 150 m3/hr (660 gpm) [Well #1]. The average flow rate was 100 m3/hr (440 gpm).

By the time of the WellJet/KAC rehabilitation effort, flow rates had dropped to a high of 90 m3/hr (396 gpm) [Well #5], and a low of 31 m3/hr (136 gpm) [Well #20]. The average flow rate was just 57 m3/hr (251 gpm) – **an average decline of** -44 m3/hr (-194 gpm), or -42%.

After rehabilitation, flow rates improved from a low of 70 m3/hr (308 gpm) [Well #4], to a high of 145 m3/hr (638 gpm) [Well #15]. Average flow rate was 118 m3/hr (519 gpm). The average flow rate improvement was +61 m3/hr (+268 gpm), or +122%.

Comparing original flow rates when the wells were new, the WellJet/KAC rehabilitations improved flow an average of +17 m3/hr (+75 gpm), or +19%.

This flow rate improvement over original performance has taken place despite a decline in static water levels throughout the wellfield of approximately -6m (almost -20').

WELLJET-KAC RESULTS - JPMC ESHIDIYA WELLFIELD

WELL NUMBER	Original (New) Flow (m3/hr)	Flow Prior to WellJet (m3/hr)	Change from Original (m3/hr)	Change from Original (%)	Flow After WellJet (m3/hr)	WellJet Improvement (m3/hr)	WellJet Improvement (%)	WellJet Improvement over Original (m3/hr)	WellJet Improvement over Original (%)
1	150	69	-81	-54.00%	140	71	102.90%	-10	-6.67%
2	100	46	-54	-54.00%	135	89	193.48%	35	35.00%
3	100	80	-20	-20.00%	120	40	50.00%	20	20.00%
4	50	40	-10	-20.00%	70	30	75.00%	20	40.00%
5	100	90	-10	-10.00%	130	40	44.44%	30	30.00%
6	100	80	-20	-20.00%	125	45	56.25%	25	25.00%
7	70	80	10	14.29%	90	10	12.50%	20	28.57%
8	100	46	-54	-54.00%	110	64	139.13%	10	10.00%
9	130	60	-70	-53.85%	143	83	138.33%	13	10.00%
10	100	46	-54	-54.00%	100	54	117.39%	0	0.00%
11	100	44	-56	-56.00%	110	66	150.00%	10	10.00%
12	100	41	-59	-59.00%	100	59	143.90%	0	0.00%
13	100	75	-25	-25.00%	120	45	60.00%	20	20.00%
14	100	47	-53	-53.00%	120	73	155.32%	20	20.00%
15	100	45	-55	-55.00%	145	100	222.22%	45	45.00%
16	100	80	-20	-20.00%	120	40	50.00%	20	20.00%
17	120	55	-65	-54.17%	120	65	118.18%	0	0.00%
18	120	53	-67	-55.83%	135	82	154.72%	15	12.50%
19	100	40	-60	-60.00%	120	80	200.00%	20	20.00%
20	70	31	-39	-55.71%	90	59	190.32%	20	28.57%
21	100	43	-57	-57.00%	125	82	190.70%	25	25.00%
AVERAGE	100.48	56.71	-43.76	-41.73%	117.52	60.81	122.13%	17.05	18.71%



JPMC Chief Executive Officer Dr. Shafik Alshkar certified the results: "On behalf of Jordan Phosphate Mines Company/JPMC, it is my pleasure to thank you and your team at KAC/WellJet for excellent performing all objectives of the rehabilitation and development of JPMC Eshidiya 21 wells. Our wells are now producing more water, with greater efficiency and lower energy consumption than when brand-new 25 years ago – after implementing unique WellJet technology."

WellJet/KAC will follow success at Eshidiya by moving on to rehabilitate JPMC's other wellfields at Russeifa and Hassa, as well as a multi-well rehab project for the Jordan Petroleum Refining Company.