Reduced Drilling Wastes Of The Operator 70% On The Average With Waste Management System

Problem Observed:

Limited space and high construction costs for Mud Pit:

Upon the investigation related with the drilling wastes of wells of Sis Enerji Üretim A.Ş. which reach minimum of 3,000 m. depth, it was observed that minimum 800 m^2 of surface area is needed to store an average of 2,500 m^3 waste for each drilling operation. High cost of agricultural lands and constructional difficulties on steep terrains were interrupting factors choosing suitable location. Furthermore, high disposal costs were faced as another problem to empty the mud pits which were full of cuttings and liquid wastes before flow tests.

Insufficient Solid Control Equipment and its effect on Drilling Fluids:

Shale shakers and mud cleaner were inadequate to hold the mud weight and solid content of drilling fluid constant or between requested ranges. This situation caused the problems listed below:

1- Increasing mud weight provoked high pump pressures leading to undesirable downhole losses or high fuel consumptions.

2- Overconsumption of some drilling fluid chemicals were faced because of increasing solid content.

3- Low rate of penetration

4- Low flow rates because of restricting screen sizes and pump pressures.

5- High dilution volumes (costs) to decrease solid content

6- High disposal costs of dumped mud

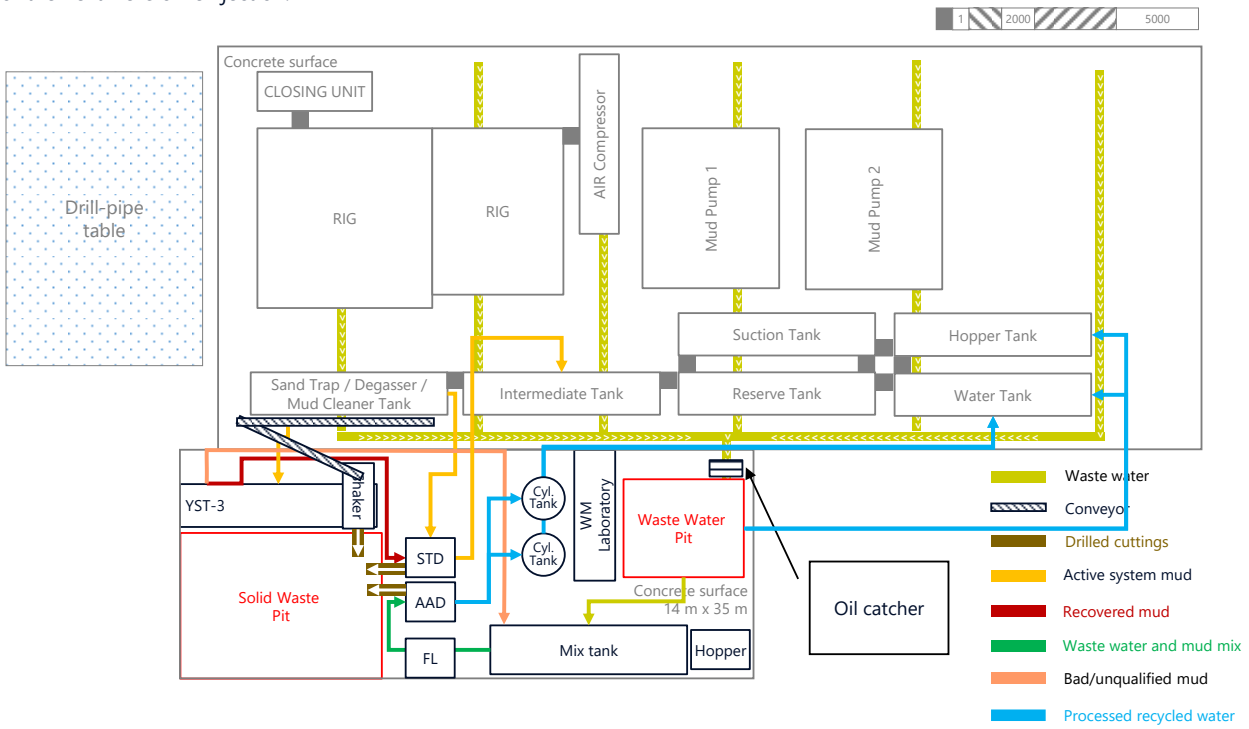
7- High NPT (non-productive time) and damage costs caused by deformation on drilling equipment like pumps, directional drilling components and pipes.

Water consumption and limited water sources:

Fresh water was used while mixing the drilling fluid, cleaning surface equipment and cooling the motors contributed 60% of the wastes during the whole drilling operation. Supplying fresh water and disposing the dirty water after operations instead of cleaning and recycling caused another cost to the Operator.

Solution Applied:

As a result of the location design performed by GEOS Energy, with 300-350 m^3 of solid storage pit and 80-100 m^3 of dirty water storage pit there was a cut down on location area and drilling operations were concluded with those pits. At the end of the drilling, solids were sent to disposal area and both storage pits were cleaned and prepared for flow test. In one of the locations where it had been planned to drill more than one well, one separate test pit was prepared and the geothermal test water was stored there, separated with the system and to be reused for the next wells or reinjection.



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Results:

During the drilling operations, mud weights were kept in minimum and safest ranges and when desired, the solid content of the mud was decreased 90% in contrast to the offset wells which had been drilled without waste management system before. As a result of the low solid content, drilling equipment were protected in highest level and penetration rates were recorded more than 2 times faster in some intervals. Thus, non-productive times and consequently total drilling costs were decreased to minimum.

	A1				A2				A3 (Off-set without WM)				B1				B3 (Off-set without WM)				B3 (Off-set without WM)			
	17 1/2''	12 1/4''	8 1/2''	Total	17 1/2''	12 1/4''	8 1/2''	Total	17 1/2''	12 ¼''	8 1/2''	Total	17 1/2''	12 1/4''	8 1/2''	Total	17 1/2''	12 1/4''	8 1/2''	Total	17 1/2''	12 1/4''	8 1/2''	Total
Footage, m	895	1405	1216	3516	874	1343	1514	3731	797	1316	1443	3556	219	1114	1024	2357	578	1334	2303	4215	272	1195	1705	
Waste Water Recovery, bbl (m^3)	590	1507	5101	7198	1187	2112	4897	8196	0	0	0	0	2183	2814	1442	6439	0	0	0	0	0	0	0	0
	(94)	(240)	(811)	(1144)	(189)	(336)	(779)	(1303)	0	0	0	0	(347)	(447)	(229)	(607)	0	0	0	0	0	0	0	0
Drilling Fluid Recovery, bbl (m^3)	82	230	3792	4104	1276	1233	834	3343	0	0	0	0	0	869	774	1643	0	0	0	0	0	0	0	0
	(13)	(37)	(603)	(653)	(203)	(196)	(133)	(532)	0	0	0	0	0	(138)	(123)	(261)	0	0	0	0	0	0	0	0
Solid Waste (Cuttings) Volume (Theoretical) bbl (m^3)	1048	806	336	2191	853	636	348	1837	934	755	399	2088	257	639	283	1179	677	766	636	2079	319	686	471	
	(167)	(128)	(53)	(348)	(136)	(101)	(55)	(292)	(148)	(120)	(63)	(332)	(41)	(102)	(45)	(187)	(108)	(122)	(101)	(331)	(51)	(109)	(75)	
Liquid Waste Volume, bbl (m^3)	579	561	512	1652	335	255	114	704	2827	4967	5802	13616	113	665	256	1035	2720	5898	7579	18170	1614	3754	4497	10528
	(92)	(89)	(81)	(263)	(53)	(41)	(18)	(112)	(449)	(790)	(923)	(2165)	(18)	(106)	(41)	(165)	(432)	(938)	(1205)	(2889)	(257)	(597)	(715)	(1674)
Total Waste Volume, bbl (m^3)	1627	1367	848	3843	1188	891	462	2541	3761	5722	6201	15704	370	1305	539	2214	3397	6664	8215	20249	1933	4440	4968	10528
	(259)	(217)	(135)	(611)	(189)	(142)	(73)	(404)	(598)	(910)	(986)	(2497)	(59)	(207)	(86)	(352)	(540)	(1060)	(1306)	(3220)	(307)	(706)	(790)	(1674)
Liquid Waste Decrement	53.70%	75.60%	94.60%	87.20%	83.20%	80.30%	80.60%	81.10%	-	-	-	-	95.10%	82.10%	88.80%	84.00%	-	-	-	-	-	-	-	-
Total Waste Decrement	**29.20%**	**56.00%**	**91.30%**	**74.60%**	**64.60%**	**66.10%**	**76.90%**	**71.80%**	**-**	**-**	**-**	**-**	**81.90%**	**71.80%**	**80.00%**	**71.40%**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

In the tables above, waste and recovery volumes are compared with the offset wells of fields A and B. It was recorded that the total amounts of wastes were decreased by up to 81.9 % by volume. In this result, recovered mud with drying shaker and recycled water played big role.

Based on three wells A1, A2 and B1; it was observed that a total of 21,833 bbl of waste water separated (cleaned) and were reused for all kind of water need of at the rig. Besides a 9,090 bbl of drilling fluid was recovered to the system. Those contributions resulted in about 35-45% drilling fluid cost off as well as saving from excessive disposal, transfer and water source costs. Built mud volumes per meter values are compared in the table below.

In conclusion, GEOS Energy contributed to the drilling operations with its waste management system as described below;

- Drilling fluid and waste disposal costs of the Operator decreased substantially,
- Solid disposal was facilitated,

Reduced NPT's, keeping the drilling fluid parameters in required ranges and protecting drilling equipment.

Built Mud in Intervals

	A1		A2		A3 *		B1		B2 *		B3 *	
Well	bbl	bbl/m	bbl	bbl/m	bbl	bbl/m	bbl	bbl/m	bbl	bbl/m	bbl	bbl/m
17,5"	2296	2.57	2453	2.81	2960	3.71	1065	4.86	3243	5.58	1657	5.94
12,25"	2460	1.75	2062	1.53	4324	3.29	1934	1.69	5055	3.78	3773	3.16
8,5"	2614	2.31	3036	2.01	3328	2.31	951	0.62	5352	2.33	2360	1.43

* **Off-set without WM**