



Tech Talk - Conditions and Treatments in North Ghawar

Posted by [Heading Out](#) on May 27, 2012 - 5:14am

Topic: [Supply/Production](#)

Tags: [ain dar](#), [aramco](#), [eor](#), [ghawar](#), [oil production](#), [saudi arabia](#), [shedgum](#), [smartwater](#), [water floods](#) [[list all tags](#)]

Recent Tech Talks have focused on the increased use of novel technology in Saudi Arabia as a means of recovering oil stranded during the waterfloods that have successfully sustained production over the past few decades. That technology is further expanded with the use of carbon dioxide injection as part of an Enhanced Oil Recovery program. The CO₂ project has been in the works [for some years](#), with an initial estimate that some 40 million cubic feet of CO₂ would be injected daily into flooded areas of the Ghawar field. The gas will come from the [Uthmaniyah Injection Plant](#) and will be initially injected into [seven wells in the Uthmaniyah](#) section of Ghawar. The initial flood will be monitored, since it is important to ensure that the [CO₂ finds the oil](#) that it will help flow to production wells.

Aramco has also [recently announced](#) success with changing the make-up of the injection water being pumped into the fields to sustain pressure. By altering the ionic composition and salinity of this water, it has been possible to significantly increase the amount of oil that is liberated and thus recovered from the reservoirs.

Ghawar is sufficiently large that it has been [divided into different segments](#), and the conditions vary between them. Because of the differences between the various regions, the overall statement that Ghawar is producing [some 5 mbd](#) has to be read with a degree of caution, lest it be presumed that this has continued to be from the same regions of the overall field. (And while this article deals with oil production, it should be noted that Ghawar also produces around 2.5 billion cubic feet (bcf) of natural gas a day.)

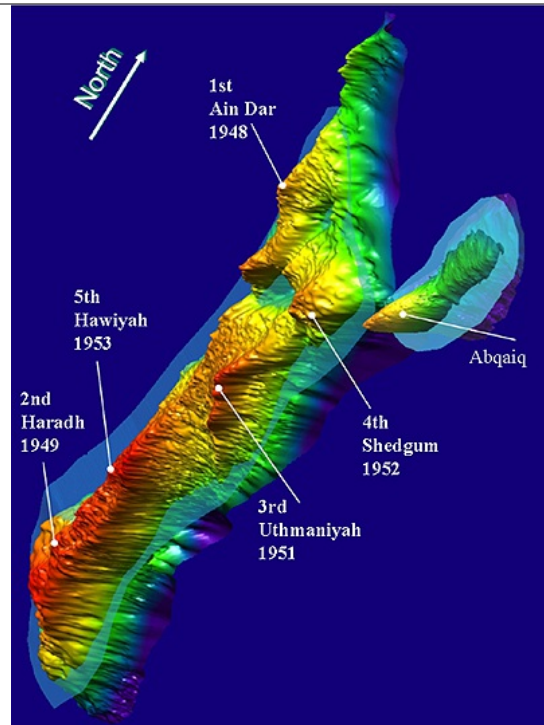


Figure 1. Sectors of Ghawar with the date of discovery ([Afifi](#))

Ain Dar came on line in 1951 with an initial yield of 15.6 kbd of dry oil, and the field was given the overall name of Ghawar, from the Bedouin name of the overlying pasture, in 1952. The original well was still producing [2,100 bd of oil in 2008](#), having by then produced a total of 152 million barrels. Down at the other end of the field, the first Haradh well was put into production in 1964, and though mothballed for a while due to lack of demand, was still also producing in 2008, at a rate of 2,300 bd – for a total production of 24 million barrels. Shedgum 1 was brought onstream in 1954, and was sidetracked with a horizontal section in 2008, which brought production back to 3,700 bd. The first Hawiyah well went onstream in 1966, and by 2008 was still producing at 4,600 bd – having by that time produced some 51 million barrels of oil.

Stuart Staniford and [Euan Mearns](#) have, among others at The Oil Drum, provided extensive sets of information on Ghawar over the years. For those who are not familiar with the region, Stuart's [early description](#) is a good place to start. In this brief overview, I will not get into any of the details of those descriptions, though I will quote one or two of the most relevant highlights. The debate initially focused on the amount of the waterflood in different regions of the field, since it was possible, with extensive work, to extract information on the rate that the water was advancing, relative to the remaining volumes in the different regions. For example, in one of his [earlier posts](#), Stuart showed the following sequence of profiles for the water progression across a section of the field at Uthmaniyah. This was followed by an additional [response from Euan](#).

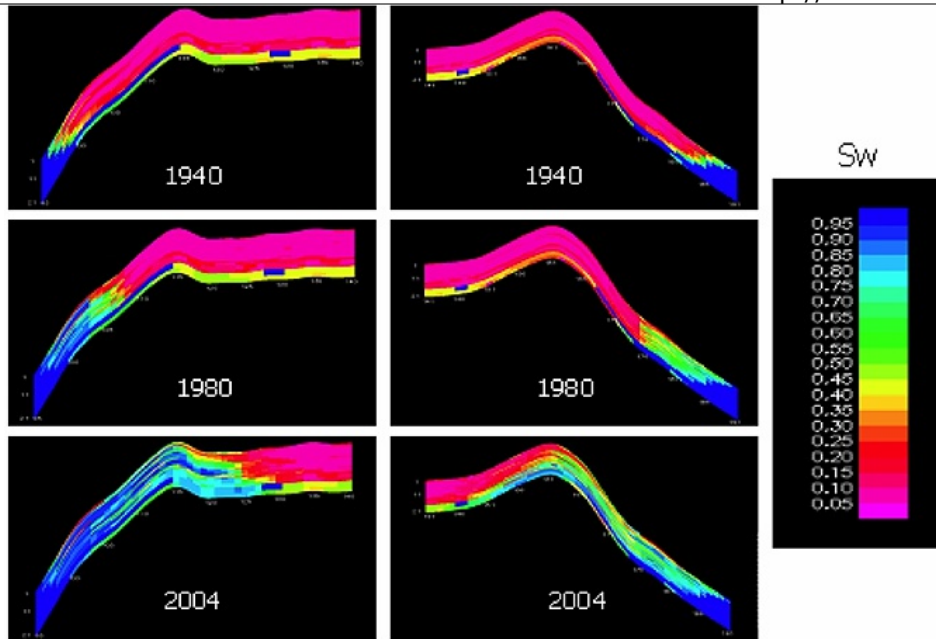


Figure 2. Sections of the Uthmaniyah region of Ghawar showing the water flood progression. (Original source: Figure 12 of Al-Mutairi et al, Water Production Management Strategies in North Uthmaniyah Area, Saudi Arabia, SPE 98847, June 2006.)

Stuart then continued this analysis into evaluating the conditions in North Ghawar (i.e. Shedgum and Ain Dar) leading him, based on figures such as this:

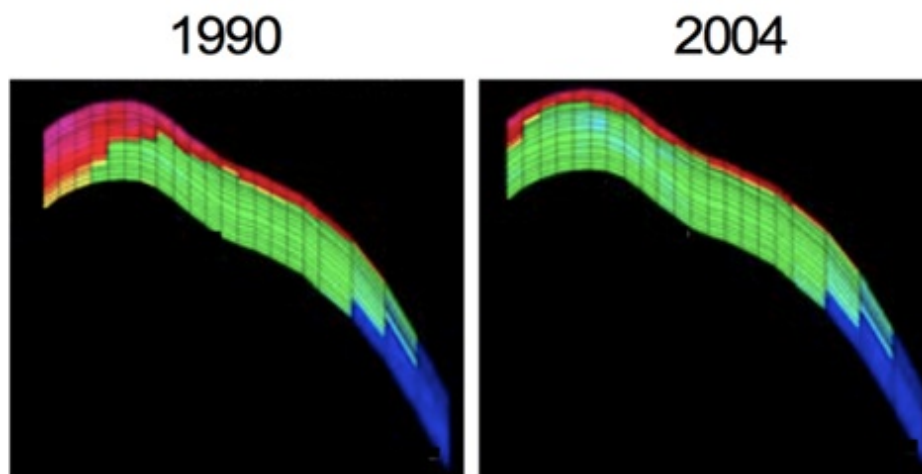


Figure 3. Section through Ain Dar region, from [Stuart Staniford](#), original source Alhuthali et al, Society of Petroleum Engineers Paper #93439, March 2005.

This led him to accept a prediction from Fractional Flow, who had [earlier noted](#) that production in Northern Ghawar had fallen (in 2007) from the 2mbd oil and 1 mbd water of 2003 to 300 kbd oil and 2.7 mbd water in 2007, as follows:

**90% or so of 'Ain Dar/Shedgum's 2mbpd could water out over the course of a few years.*

**We are likely somewhere in the midst of that process.*

**That is likely the explanation for most of the Saudi production declines we have seen since June 2005 (including the failure of Haradh III and Qatif/Abu Safah to raise production).*

The discussion at the time (which is still present in comments under the main papers) was fascinating, since it was based, inter alia, on information such as the speed at which [the water front was advancing](#).

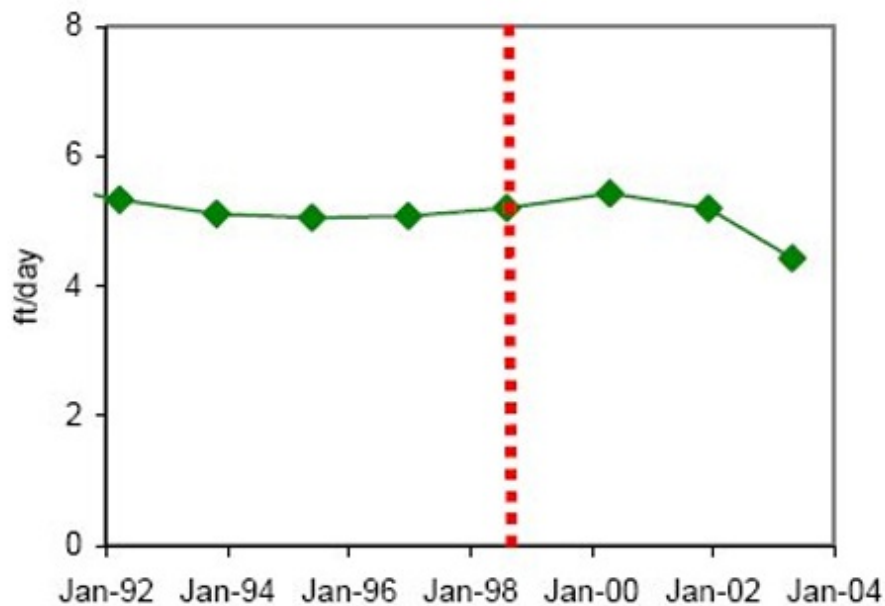


Figure 4. Speed of water front advance in North Ghawar ([Fractional Flow](#)).

The use of horizontal wells and MRC [came late](#) in the development of North Ghawar, which is why the use of carbon dioxide injection for EOR, smartwater injection, induced fractures, and long horizontal wells to capture otherwise stranded oil, will play [a more important part](#) in the production from the region.

What these new technologies bring with them is the ability to go back into the older regions of Ghawar and extract some of the oil that was left in place during the original water floods. Because a number of them will be dealing with regions of the reservoir that are already flooded, so that the oil will be coming from wells with a high water cut, it is, in my opinion, unlikely that these will allow increases in production from the region, but rather it will sustain existing production levels somewhat further into the future than we (the collective wisdom of the TOD writers) have predicted in the past.

But Ghawar is not just the original wells of the North, and I will have more to say about the field, and then about other fields in the country, in future posts.



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