



Environment

The Environmental License Process for Produced Water

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Most often, the process of producing crude oil does not take place by producing just one single fluid; it almost always comes along with other fluids, notably natural gas, water or both.

These two 'by-products' may represent a hindrance for an operator willing to maximize just one steam: the crude oil one. Such a hindrance usually arises from two sources: technical, and environmental (on top of these two, the natural gas may face an additional one: finding a suitable market for it.)

Regarding the technical aspect, let's first define two key concepts: GOR, and BSW. When crude oil is produced in conjunction with natural gas, the Gas Oil Ratio (GOR) factor is used to describe the amount of gas (in million standard cubic feet or mmscf) embedded in one barrel of crude oil produced. By the same token, when crude oil is produced in conjunction with water, the Basic Sediment & Water (BSW) term is used to indicate the percentage water present in a barrel of the combined fluids produced: so a '10% BSW' means that out of a barrel of fluids produced, 10% is water (and sediments) and 90% is crude oil.

Thus, the initial production period of a field is normally the 'best' since both GOR and BSW exhibit low values, hence most of the produced fluids is crude oil. As time passes by they worsen meaning that in order to get a single barrel of crude oil large quantities of water (or natural gas) has to be produced. However, producing increasing quantities of water is not a problem per se; the problem is how to handle such produced water (aka 'formation water' or 'connate water'). The very first issue is about deciding the size of the facilities to handle such produced water since the bottleneck will be dictated by it, not by the crude oil (the same applies in the case of

natural gas, but we will continue discussing the water situation).

And the second issue, the environmental one, is about disposing the water: it may be too hot, too salty or it may contain sulfur, heavy metals, etc., all of them hazardous for the environment hence preventing its direct disposition into a river or over the terrain. Moreover, some of these substances would also damage the facilities themselves. So the water has to be treated in order to get an output stream with certain quality and characteristics regulated by governments.

In Colombia, such regulations are set by the Ministry of the Environment (MinAmbiente) under Decrees 3930 and 4728 from 2010 which replaced Decree 1594 from 1984 and set more stringent standards (plus Law 1333 / 1999 that sets the penalties for failing to meet standards). And of course, more stringent quality standards for the water to be disposed translate into higher operational costs.

There are different technical options to dispose of the water which will dictate the treatment requirements. These options include:

- i. Disposal on the surface (water stream, land or sewage);
- ii. Re-injection for disposal into an inactive reservoir (aquifer);
- iii. Re-injection for Enhance Oil Recovery (EOR) into the same reservoir

Of course, not all the options are always feasible: the decision would depend on many factors such as the (physical and chemical) characteristics of the water, the amount of water being produced, the existence of inactive reservoirs, EOR efficiency, etc. Assuming all them were available though, the third one (EOR) would be the preferred choice provided it were

technically feasible and made economic sense. In such a case, it would be MinMinas that has the say rather than MinAmbiente.

Conversely, options one and two would be in the reign of MinAmbiente. The disposal by means of drilling one or more wells to re-inject the produced water into a non-producing formation has to make sure the injected water does not leak into fresh water streams. The disposal to the surface is a three-step process basically consisting on removing all contaminating particles (sodium, chlorides, heavy metals like barium, mercury, arsenic and selenium; sulfurs; oils and fats; and salts) present in produced water before deploying it.

Currently, the regulations regarding water treatment are in the middle of a transition period between the aforementioned Decrees: 1594/1984 and 3930/2010, as follows:

- Those who had a disposal license obtained before Decree 3930 was issued (October 25) would have 24 months to adopt the standards of the new regulation. The others would have 18 months.

- Oil companies who adopt plans for technological re-conversion would be allowed 36 months, in addition to the 24 months allowed for those within the transition period, provided they fulfilled the standards set by Decree 1594 by the time Decree 3930 was issued. Otherwise they would just have 24 months in addition to the 18 months.

Bottom-Line: Water treatment permits are taking much longer than they should normally take because of this transition period and the National Environmental Licensing Agency (ANLA) is in the middle of setting up procedures. Considering these delays, BSW is an important factor in planning the development of wells.