

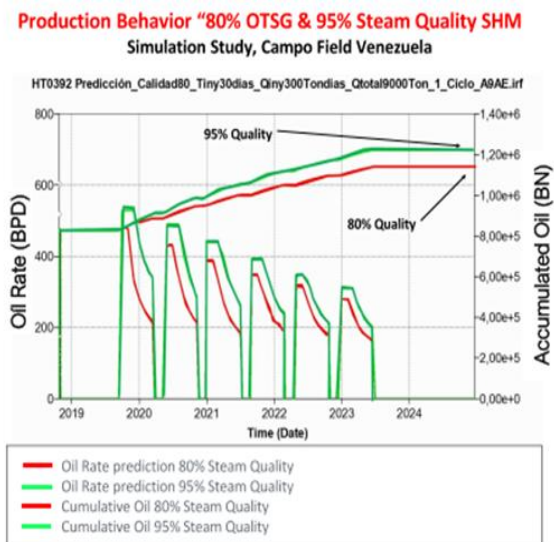


PRESENT AND FUTURE: THERMAL RECOVERY TECHNOLOGIES

STEAM QUALITY

Steam quality is one of the main parameters within thermal recovery projects, since it is a direct measure of the efficiency of the heat transmission process into the reservoir with highly viscous crudes. The essence of the Enhanced Oil Recovery projects is focused on affecting the residual oil saturation and with this achieving a significant increase in the Recovery Factor of the hydrocarbon in place of heavy oil fields. The effectiveness in the process of heat transmission to the reservoir is directly proportional to the quality of steam obtained during the injection under its different schemes such as Alternate Injection, Continuous Injection, SAGD, HASD, etc. Thus, obtaining high steam qualities above 80% is strictly necessary; It should be noted that conventional OTSG generators have certain limitations in their design and operation which limit reaching high quality values.

To address this technological challenge, Nakasawa has developed the **Super Matroid Heater Technology which allows 95% Quality** to be delivered to the equipment's output, generating dry steam without loss of condensate, without generating effluents or loss of mass, obtaining an extra 12% of heat and 15% more steam quality, increasing the profits of oil produced, which translates into a projection of higher income.



CONVENTIONAL SYSTEMS (OTSG) VERSUS SUPERMATROID HEATER (SMH)

The high-quality steam system consists of a high-efficiency cyclone steam separator, super heater tube bundle, mixers with control valve, and steam-quality sampling system. Nakasawa's SMH process involves controlled condensate separations and remixes to achieve steam quality up to 95%, so there is no condensate loss, and the total mass goes to the system outlet and injection point.

The Super Matroid Heater presents various technical and economic advantages compared to the use of conventional systems, highlighting:

- Generates + 12% Extra Heat
- Save 9-12% less treated water.
- Decrease of 12 to 20% of operational expenses and injection days.
- Generates 9 to 15% extra oil produced, due to the extra heat injected into the field.
- It is the only technology that guarantees 95% steam quality with that amount of TDS.
- Conventional Technology cannot guarantee to generate 80% of Surface Quality with TDS of 8,000 to 10,000 TDS

MAIN FEATURES	NK-SMH 95% SQ	OTSG 80%
STEAM GENERATION ADVANTAGES		
STEAM QUALITY	95%	<80%
THERMAL EFFICIENCY	88-92%	<88%
INJECTED STEAM	12 % Extra	Nominal Capacity
FUEL CONSUMPTION	Saving 12%	Nominal Capacity
TREATED WATER	9 - 12% lower	Nominal Capacity
OIL PRODUCTION AND HEAT INJECTION ADVANTAGES		
OIL PRODUCTION (STB/D)	9 - 15 % Extra	Lower
CUMULATIVE PRODUCTION	10 - 15 % Extra	Lower
ENERGY TO THE RESERVOIR	Higher	Lower
HEAT TRANSFER	Higher	Lower
STEAM QUALITY @ 4000' TVD	0,8	<65%
HIGHER TDS MANAGEMENT ADVANTAGES		
TDS HANDLING	4000 - 10000	<4000
MAINTENANCE	Regular Frequency	Higher Frequency
CONDENSATE SEPARATION FOR THE FINAL PHASE	No Generation	No Generation
GENERATED EFFLUENTS	No Generation	No Generation
TOTAL SOLID AT THE SYSTEM OULET	-	-
SOLID PRECIPITATION (SCALE)	No Generation	No Generation
SURFACE FACILITIES STEAM INJECTION ADVANTAGES		
SURFACE HEAT LOSSES	Lower	Higher
STEAM QUALITY IN THE WELL HEAD	Higher	Lower
STEAM QUALITY WITH THE GENERATOR PLACED 3 KILOMETERS FROM THE WELL HEAD	85%	70%
MATERIALS AND DESIGN ADVANTAGES		
TUBINGS / MATERIALS	SA213 T12 more resistant	SA106 Sch.160
TUBING QUALITY	chrome - nickel alloy	Less Resistant
RADIANT SECTION TUBING SUPPORT	25 % chrome and 20 % nickel alloy	Less Resistant
SUPPORT RING	Protective Insulation	Less Resistant
GENERATOR HOUSING	Anticorrosion	Less Resistant
H2S DETECTOR	Included	Not Included
COST AND REVENUES ADVANTAGES		
OPERATIONAL COSTS (decrease of injection days)	Decrease 12%	Increase
REVENUES (higher cumulative oil production)	Increase 12%	Decrease