

APIN Enhanced Oil Recovery Steam Generators

Once-through steam generators for enhanced heavy crude oil recovery

Apin is a manufacturer of enhanced oil recovery (EOR) once-through steam generator design used extensively in California, Canada, Indonesia, South America, China, Russia and other parts of the world. The EOR process involves injecting steam into reservoirs to make the oil less viscous, thereby improving its mobility and recovery while maintaining reservoir pressure.

The EOR once through steam generator design is manufactured in a very modern plant in Lima, Peru, founded by Engineer Jean Gerber in 1946, also manufacturing Drum type APIN Boilers, as well as Heat Exchangers, Condensers and Refinery equipment, exported Worldwide..

Standard APIN Steam Generators

A large part of the crude oil reserves of the world are in the form of heavy crude oil and oil sand deposits. This heavy oil cannot be recovered through usual oil production methods. The steam created by the generator is injected into the oil reservoir. The heat and pressure from the injected steam decreases the viscosity of the oil, thus causing it to flow to the well bore.

Since 1968, Tecnolog s.a. has led the way with efficient, innovative products for all types of Boilers and water heaters. APIN Boilers (Brand name owned by Tecnolog)

Now, APIN offers standard steam generators that range in size from 10 to 250 MMBtu/hr., with larger units available in custom designs. All are designed to meet or exceed the 80% steam quality standard for steam generators. They are designed to operate at pressures up to 3200 psig .

Features and benefits of the APIN EOR steam generators

- Handles zero hardness feedwater with high total dissolved solids content
- Completely shop assembled with minimum field work
- Readily portable for ease of relocation at other sites
- Responds to rapid and significant changes in load demand as dictated by the injection well requirements
- Designed and constructed for easy maintenance
- Operates efficiently over a wide steam pressure range up to the design pressure
- Operates largely unattended with a minimum of operator attention
- Highly reliable



Proven Design for Dependable Operation

The APIN steam generator is designed to handle feedwater containing significant amount of total dissolved solids, provided the feedwater has been softened to essentially zero hardness. A maximum of 80% of the feedwater is vaporized to provide sufficient liquid at the outlet of the steam generator to keep the water-soluble solids in solution. Many years of experience have shown that there is virtually no fouling of the internal surfaces of the tubes when the feedwater is properly softened. This proven design operates satisfactorily with feedwater having a much higher total dissolved solids content than is permissible with conventional high pressure boilers.

Since the objective of a steam injection installation is to get heat into the oil bearing strata, the usual practice is to inject the combined steam-water mixture leaving the steam generator into the injection well. The liquid present at the steam generator outlet contains a considerable amount of heat which can be transferred to the oil sands and can also provide added volume for displacement of oil from the strata. Where desirable, a separator can be incorporated in the steam generator design to make 100% quality steam available for injection. Heat can be recovered from the separated water so that the steam generator thermal efficiency is not significantly affected when producing the high quality steam.

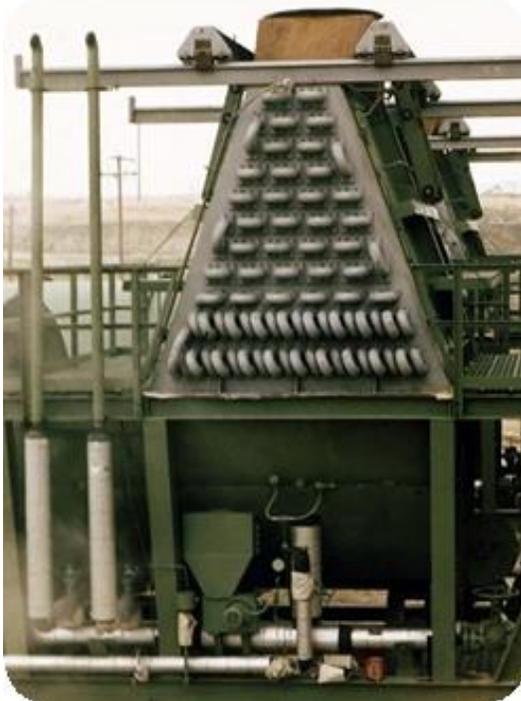
The APIN Once Through steam generator consists of a radiant section and a convection section. The radiant section tubes receive heat by direct radiant absorption from the combustion envelope of the flame. The highest rates

of heat transfer and the maximum tube wall temperatures are experienced in the radiant section.

The convections section consists of several rows of bare shock tubes plus multiple rows of extended surface tubes designed for efficient heat transfer. The function of the shock tubes is to shield the extended surface tubes from exposure to direct radiant heat. The shock tubes receive heat by both radiant and convection heat transfer.

The extended surface tubes are designed to receive heat primarily by convection heat transfer, although there is some low-level radiant heat transfer from the high temperature flue gases.

The upper rows of the convection section are provided with extended surface tubes to maximize heat transfer. Because of the low heat transfer film coefficients which are achievable with flue gases, a high ratio of external surface to inside tube surface, provided by fin tubes, is very effective in improving the heat absorption capability of the tubes. The fins are hydraulically placed on to the tubes for full contact and high fin efficiencies. The fins are widely spaced to minimize the tendency for fouling when firing with heavy fuel oil. Fin tip temperatures are maintained well below the temperature at which significant metal oxidation would occur.



A cross-flow convection section is designed for uniform flue gas velocity for enhanced performance and ease of maintenance.

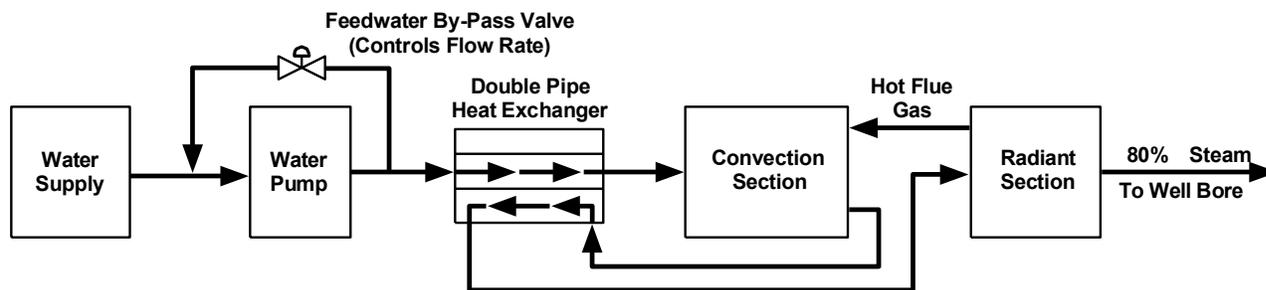


Radiant section tubes are supported by special design, slip type high alloy hangers spaced evenly along the tube length.



To meet varying geographic location, fuel, steam and economic conditions, APIN offers a complete line of auxiliary equipment, like this steam generator burner system.

Generator Flow



APIN EOR Steam Generators (Standard Sizes)

Unit Size	Absorbed Heat		Approximate Dimensions			Approximate Weight
	Btu/hr	Boiler HP	Length	Width	Height	
OT-10	10,000,000	314	42 ft	8 ft - 0 in.	14 ft - 3 in.	80,000 lb
OT -18	18,000,000	553	51 ft	9 ft - 2 in.	14 ft - 0 in.	105,000 lb
OT -22	22,000,000	657	56 ft	9 ft - 2 in.	16 ft - 3 in.	110,000 lb
OT -25	25,000,000	747	57 ft	9 ft - 2 in.	16 ft - 3 in.	130,000 lb
OT -30	30,000,000	896	60 ft	10 ft - 8 in.	12 ft - 4 in.	140,000 lb
OT -50	50,000,000	1494	81 ft	11 ft - 10 in.	20 ft - 7 in.	230,000 lb

Unit Size	Approximate Feedwater Flow Rate From 100F - Outlet 80% Quality - 1000 psig						Fuel Oil Basis 130 MBtu/Gal.		Gas Feed Basis 1000 Btu/SCF	
	GPM	lb/hr	BPH	BPD	Tons/hr	Tons/Day	GPD	BPD	MSCFH	MSCFD
OT -10	19.2	9,600	27.4	657	4.8	115.2	1,881	44.8	11.36	272.7
OT -18	34.5	17,280	49.3	1183	8.6	207.4	3,386	80.6	20.45	490.9
OT -22	42.2	21,120	60.3	1147	10.6	253.4	4,138	98.5	25.00	660.0
OT -25	47.9	24,000	68.5	1644	12.0	288.0	4,702	112.0	28.41	681.8
OT -30	57.5	28,800	82.2	1972	14.4	345.6	5,643	134.4	34.10	818.2
OT -50	95.9	48,000	137.0	3288	24.0	576.0	9,405	223.9	56.82	1363.6

Tables show standard sizes available. In addition to offering the most complete line of enhanced oil recovery steam generators available, APIN can also design special units to meet your exact requirements.

Fully Self-Contained Trailer-Mounted Units

Tecnolog can provide fully self-contained APIN EORSGs trailer-mounted steam generating units ranging in size from 22 to 50 MBtu/hr. The units are quickly and easily moved from one oil field to another. Minimal field work is required to prepare the generator for operation after transportation and simply requires connecting the unit discharge piping to the well, connecting feedwater to the pump, connecting electrical power, and connecting the fuel supply to the generator.

Standard Sizes for Trailer-Mounted Steam Generators

Unit Size	Absorbed Heat		Approximate Dimensions			Approximate Weight
	Btu/hr	Boiler HP	Length	Width	Height	
OT -22	22,000,000	657	54 ft	9 ft - 2 in.	16 ft - 3 in.	110,000 lb.
OT -25	25,000,000	747	57 ft	9 ft - 2 in.	16 ft - 3 in.	130,000 lb.
OT -30	30,000,000	896	60 ft	10 ft - 8 in.	12 ft - 4 in.	140,000 lb.
OT -50	50,000,000	1494	81 ft	11 ft - 10 in.	20 ft - 7 in.	230,000 lb

