
Cost Analysis of Infracone Sonic Cleaners

- A Return of Investment Study -

Infracone
Midskogsgränd 11, 1 tr
SE - 115 43 Stockholm, Sweden
www.infracone.biz

Tel: +46 8 661 33 10
Fax: +46 8 661 33 60
E-mail: info@infracone.se

1 Summary

An Infracone sonic cleaner is used for keeping economizers, catalysis, oil-fired boilers, and gas ducts clean from soot. It eliminates or dramatically reduces the need for soot blowing, chemicals and water washing. Many ship owners do not consider soot blowing, chemicals and water washing as a big cost. However, such costs are very noticeable looking at a one-year perspective.

After making an Infracone installation the cost savings will be significant. The estimated time for return on investment is less than one year.

Costs saved by using a sonic cleaner

- Chemicals	0 / 4 000
- Consumption of steam when soot blowing	17 280 / 21 600
- Increased oil costs for the oil-fired boilers	9 750
- Reduced water washing	12 600
- Reduced economizer repair job	2 083
- Soot fires	3 500
- Soot marks on deck	7 000
- Soot marks on passengers	7 000
- Spare parts, service and maintenance of steam soot blowers	4 000 / 8 000

Total yearly average cost saved by Infracone

USD 63 213 – 75 533

Costs of sonic cleaner

- Installation, paid over a 10 years period	3 000
- Spare Parts, Crew Service and Maintenance Costs	2 000
- Compressed Air	480
- Service Visit	667

Total yearly average cost of Infracone

USD 6 147

Note that these figures are not applicable for all vessels. However, Infracone has collected the numbers from different customers, different types of vessels at different points of time in order to get as valid information as possible for a standard type of cruise vessel. If anyone reading this material has figures that differs from this document or any other comments regarding costs and cost savings, Infracone would like to share that information.

2 Costs saved by using an Infracone Sonic Cleaner

2.1 Chemicals

Not all economizers are in the need of chemicals. If they are, the average cost per year is USD 4,000 per economizer. NOTE that chemicals also have a very negative affect on the environment and regulations in the use of chemicals will only increase in the future.

2.2 Consumption of Steam when Soot Blowing

Every economizer is normally equipped with 4 steam soot blowers, each one with about 10 nozzles. Each nozzle opening diameter is about 5 mm. If the gas velocity from each nozzle is 150 m/s, the gas flow is $3 \times 10^{-3} \text{ m}^3/\text{s}$.

If each soot blower is operated for 5 minutes (300 s), the total steam consumption for one soot blower nozzle is $300 \times 3 \times 10^{-3} = 0,9 \text{ m}^3$ per operation. The consumption for 10 nozzles is $9 \text{ m}^3/\text{operation}$. The consumption for all 4 soot blowers is then $36 \text{ m}^3/\text{operation}$. If the steam soot blowers are operated 300 times every year the total consumption is $300 \times 36 = 10\,800 \text{ m}^3$.

The cost of water is USD $2/\text{m}^3$, which gives a total cost for steam that is USD 21 600.

Two cases are common:

Case 1. No steam soot blowers are installed or dismantled, total cost save is USD 21 600.

Case 2. The use of the steam soot blowers are reduced by 80 %, total cost save is $0,8 \times \text{USD } 21\,600 = \text{USD } 17\,280$.

2.3 Increased Oil Costs for the Oil Fired Boilers

Fouling of the heating tubes in an EGE means higher outlet exhaust gas temperature and less production of steam. The question is now: What is the loss in terms of money if the outlet gas temperature increases by one degree centigrade?

Average temperature increase

If the outlet gas temperature increases one degree centigrade from a water washing to next water washing that means that the average temperature increase over the period is 0.5 degree centigrade.

Heat quantity

If the mass rate of exhaust gas flow is 50 kg/s, that corresponds to a heat loss of $0.5 \text{ (C)} \times 50 \text{ (kg of gas/s)} \times 1 \text{ (kJ/C,kg)} = 25 \text{ kJ/s}$ corresponding to a heat loss of $25 \times 3600 = 90\,000 \text{ kJ}$ per hour.

Heat production by an oil fired boiler

The heat capacity of oil is in the range of 40 000 kJ/kg. If an oil fired boiler has an efficiency of 80 % that means that 1 kg of oil produces 32 000 kJ heat. That means that a heat loss of 90 000 kJ corresponds to a consumption of $90\,000/32\,000 \approx 3$ kg of oil per hour.

Cost

If the EGE is in operation 3 000 hours per year that means that the fouling of the EGE tubes has to be compensated by burning $3 \times 3000 = 9\,000$ kg = 9 tons of oil per year. If the cost of oil is US\$ 240/ton that corresponds to a cost of $9 \times 240 = \text{US\$ } 2\,160$ per year.

Total cost

If now the temperature increase is 5 degrees centigrade on average between each water washing instead of 1 degree centigrade, the total cost is $5 \times 2\,160 = \text{USD } 10\,800$.

Estimated that one sonic cleaner is able to reduce 90 % of the above heat loss. The total cost savings for oil are $0,9 \times \text{USD } 10\,800 = \text{USD } 9\,750$.

2.4 Reduced Water Washing

Water washing will be reduced if a sonic cleaner is used. Normally an economizer is cleaned every month for 5 hours. Estimated time for preparations is 2 hours and for disposing the used water 3 hours. Total time spent is 10 hours. It takes 4 people to do this job, which results in 40 man-hours. If 1 man-hour equals USD 30 in total cost, water washing costs USD 1 200 each time.

The cost for water is USD 2 and about 10 m^3 is used at each water washing. The cost for handling the disposed water is approximately twice the cost compared with purchasing it. The cost for 1 m^3 is then USD 6 and the total cost for water washing one time is USD 60. Each water washing costs $\text{USD } 1\,200 + \text{USD } 60 = \text{USD } 1\,260$.

One Infracone sonic cleaner reduces the number of water washings from 12 to 2 each year, which yields $\text{USD } 1\,260 \times 10 = \text{USD } 12\,600$ in savings.

2.5 Reduced Economizer Repair Jobs

An economizer needs to be repaired on average every 8 years (normally caused by corrosion and erosion of water tubes, from water washing and steam blowing). Each repair job costs approximately USD 50 000. A sonic cleaner increases the time between repair jobs from 8 to approximately 12 years.

The yearly savings are: $(50\,000/8 - 50\,000/12) = 6\,250 - 4\,167 = \text{USD } 2\,083$

2.6 Soot Fires

Normally a cruise vessel having four exhaust gas economisers has one soot fire every 10 years, causing a cost of approximately USD 200 000. The average cost for one economiser is then USD $(200\ 000/10 \times 4) = \text{USD } 5\ 000$. One sonic cleaner reduces the risk for soot fires with approximately 70 %, giving an average cost save of $0,7 \times \text{USD } 5\ 000 = \text{USD } 3\ 500$.

2.7 Soot Marks on Passengers

Approximately 100 passengers per year have to be compensated for clothes or other personal items destroyed by soot flakes. They each get about USD 100, which equals USD 10 000 per year. The sonic cleaner reduces the complaints from the passengers with about 70 % by reducing the fallout of soot flakes from the funnel. This indicates a total cost save of $0,7 \times \text{USD } 10\ 000 = \text{USD } 7\ 000$.

2.8 Soot Marks on Deck

The cost for destroyed deck furniture is approximately USD 10 000 per year. The sonic cleaner reduces the destroyed items by 70 %, which results in cost savings of about $0,7 \times \text{USD } 10\ 000 = \text{USD } 7\ 000$.

2.9 Spare Parts, Service and Maintenance of Steam Soot Blowers

Spare parts, service and maintenance of steam soot blowers costs approximately USD 2 000/year/steam soot blower. Average number of steam soot blowers per economiser is 4, which gives a total cost that is $4 \times \text{USD } 2\ 000 = \text{USD } 8\ 000$.

There are two common cases experienced by our customers:

Case 1. If the steam soot blowers are removed or never installed the yearly total cost saved is USD 8 000.

Case 2. If the steam soot blowers still are used, but less frequently, the total cost saved is approximately 50 % of USD 8 000 = USD 4 000.

3 Costs from Installing and Using a Sonic Cleaner

3.1 Installation Cost

Average installation cost/sonic cleaner (including cost for hardware, part in compressed air piping, compressor, cabling, control system and installation), is USD 30 000. Expected economical and technical lifetime at least 10 years, which gives an average cost that is USD 3 000/year

3.2 Spare Parts, Crew Service and Maintenance Cost

Spare parts, crew service and maintenance, USD 2 000/year.

3.3 Compressed Air

Operation cost for compressed air. Each time the unit insonates (is in operation), it consumes about 1 Nm³. Normally each unit insonates 6 times every hour that the corresponding engine is in operation and each engine is in operation approximately 4 000 hours/year. The total compressed air consumption is then $1 \times 6 \times 4\,000 = 24\,000$ Nm³/year. If the average cost for compressed air is USD 0,02/Nm³ the total cost is $24\,000 \times 0,02 =$ USD 480.

3.4 Service Visit

Once a year it is recommended having one Infracone engineer attending for service and tuning of the sonic cleaners. Average cost for the service visit is USD 4 000. Each vessel is on average equipped with 6 sonic cleaners giving an average cost /sonic cleaner at $4000/6 =$ USD 667.