Buitink Technology
Attn: R. de Vries Msc
Typographer 1
6921 VB DUIVEN

Ermelo, Jan. 12, 2023

Subject: Energy cost savings of a pool outdoor slide through insulation measure (vs 1.1) Note: This is

subject to change

Dear Mr. de Vries,

You asked me on January 7 to do energy analyses on an outdoor slide of a swimming pool. This involves determining the expected annual gas cost savings due to the post-insulation of such a slide.

You were referring to 2 possible measures:
- Applying a polyester wool package of 10 cm OR
- One package of 15-cm polyester wool

Buitink Technology has these products available to its customers.

We made assumptions in advance to make this calculation. These assumptions are conservative in nature. This means that when applied, the annual gas savings will be close to the calculation with fairly high certainty. Field measurements "in situ" are unfortunately not easy because the water goes up through the slide in the collective of pool water heating.

The factors that may affect your client during the application are:
- The duration of the annual opening of the slide
- The water temperature of the pool water flowing through the slide
- The efficiency with which swimming water is heated with natural gas, or the application of another heat source such as a heat pump, for example
- To what extent the slide is primarily open during the summer months rather than the winter months

One factor we cannot influence is the average outdoor air temperature during slide use. That varies from calendar year to calendar year. That gives an uncertainty of plus or minus 6% around the calculated average.

In the calculation, we assumed a swimming water temperature of 30.0°C and an average outdoor temperature during use of 10.5°C. This is near the long-term average of measuring station 'De Bilt'. Furthermore, we assumed average use of 12 hours per day throughout the year. So 12 hours of opening per day in winter and also 12 hours per day in summer.

Also keep in mind that this outdoor temperature still varies with the geographical position of the pool in the Netherlands. Near the city of Groningen the average outside temperature is lower than in Vlissingen, for example. That gives in the gas consumption for the slide still a variation in the order of

9% above and 9% below 'De Bilt' climate average.

In the calculation, at your request, I assumed a slide with a total length of 50 (m) and a tube outer diameter of 1.2 (m). The slide tube has a wall thickness of 5 mm and is made of polyester. Furthermore, we assume a natural gas price of € 1.50 including surcharges and VAT.

Based on all these "De Bilt" assumptions, I did a calculation mindful of the common physics of heat transport through insulated surfaces. We had to estimate the so-called transition resistances of heat transport from pool air to the tube and from the tube to the outside air. Especially the transition resistances (Rsi and Rse) are critical in approximating the gas consumption of an uninsulated slide tube.

I have calculated two types of post-insulation for you with the following results:
- The calculated gas consumption reduction of a 10 cm polyester wool (Rc = 3.06) is about 11,000 (m3/year) with an annual savings in natural gas costs of about €16,500

- The calculated gas consumption reduction of a 15 cm polyester wool (Rc = 4.29) is about 11,150 (m3/year) with an annual savings in natural gas costs of about €16,700

The input data and calculation results used, I have put together Appendices A. and B. for you.

In the calculations I have assumed assumptions that you have provided. They seem plausible to me but the responsibility for those input parameters and therefore the calculation results lie with Buitink Technology.

If a custom calculation is needed with different slide dimensions, and/or different duration of use, a different heat source for swimming water or different energy cost price I can take care of that for you. If on second thought you also wish to adjust the assumptions I can adjust the calculations accordingly. Think for example of daily usage time that varies with the outside temperature in connection with energy saving measures that the swimming pool operator wants to implement.

I omit the calculation of the net present value of energy cost savings with rising gas prices during long-term deployment of insulation here because you want to do it yourself.

For now, I wish you success in applying this beautiful and practical innovation that contributes to the Dutch government's climate goals.

Kind regards

Ir. René de Brouwer
Evanston Consulting
Certified Passive House consultant (installations and thermal building
envelope) Tel. 06 - 45 22 26 59

Appendices: Input parameters and calculation results for 10 and 15 cm post-insulation

Bijlage A: Berekening van glijbaan met 10 cm polyester wol naisolatie

Buitenglijbaan energiekostenbesparing door isolatie

donderdag 12 januari 2023	Rekenmodel vs 0.4	
Isolatie-ingreep	10 cm polyester wol	

Karakteristieken van glijbaan en omgeving	Waarde	Eenheid
Glijbaan lengte:	50,0	m
Ongesioleerde glijbaan buitendiameter:	1,20	m
Gemiddelde buitentemperatuur in jaar:	10,5	°C
Gemiddelde binnentemperatuur in jaar:	30,0	°C
Gebruik per jaar:	4.380	uren/jaar
Energierendement zwemwater verwarming:	85%	Procent
Verbrandingswaarde aardgas:	35,17	MJ/m3
Overgangsweerstand in de glijbaan Rsi:	0,10	m2.K/W
Overgangsweerstand buiten de glijbaan Rse:	0,04	m2.K/W
Aardgasprijs (incl. toeslagen en BTW): €	1,50	per m3
Temperatuurverschil buiten-binnen:	19,5	°K

Ongeisoleerde buitenglijbaan op jaarbasis		
Warmteweerstand kunststof glijbaan Rc:	0,025	m2.K/W
Totale warmteweerstand Rτ (incl. Rse en Rsi):	0,17	m2.K/W
Warmtegeleidingscoëfficiënt ongeisoleerde glijbaan:	**6,06**	W/m2.K
Buitenoppervlakte ongeisoleerde glijbaan:	188	m2
Thermisch verlies door buis buitenoppervlak:	97.572	kWhth/jaar
Aardgasverbruik ongeisoleerd:	11.700	m3/jaar

Geisoleerde buitenglijbaan op jaarbasis		
Dikte van isolatielaag:	0,10	m
Warmteweerstand van glijbaan plus isolatie Rc:	3,06	m2.K/W
Totale warmteweerstand Rτ (incl. Rse en Rsi):	3,20	m2.K/W
Warmtegeleidingscoëfficiënt geisoleerde glijbaan:	**0,31**	W/m2.K
Buitenoppervlakte geisoleerde glijbaan:	220	m2
Thermisch verlies door geisoleerde buisoppervlak:	5.870	kWhth/jaar
Aardgasverbruik geisoleerd:	700	m3/jaar

Aardgas en kostenbesparing per jaar door isolatie ingreep		
Geschatte aardgasbesparing:	11.000	m3/jaar
Geschatte aardgaskostenbesparing:	**€ 16.500**	euro/jaar

Bijlage B: Berekening van glijbaan met 15 cm polyester wol naisolatie

Buitenglijbaan energiekostenbesparing door isolatie

donderdag 12 januari 2023		Rekenmodel vs 0.4	
Isolatie-ingreep	15 cm polyester wol		
Karakteristieken van glijbaan en omgeving		Waarde	Eenheid
Glijbaan lengte:		50,0	m
Ongesioleerde glijbaan buitendiameter:		1,20	m
Gemiddelde buitentemperatuur in jaar:		10,5	°C
Gemiddelde binnentemperatuur in jaar:		30,0	°C
Gebruik per jaar:		4.380	uren/jaar
Energierendement zwemwater verwarming:		85%	Procent
Verbrandingswaarde aardgas:		35,17	MJ/m3
Overgangsweerstand in de glijbaan Rsi:		0,10	m2.K/W
Overgangsweerstand buiten de glijbaan Rse:		0,04	m2.K/W
Aardgasprijs (incl. toeslagen en BTW): €		1,50	per m3
Temperatuurverschil buiten-binnen:		19,5	°K
Ongeisoleerde buitenglijbaan op jaarbasis			
Warmteweerstand kunststof glijbaan Rc:		0,025	m2.K/W
Totale warmteweerstand Rτ (incl. Rse en Rsi):		0,17	m2.K/W
Warmtegeleidingscoëfficiënt ongeisoleerde glijbaan:		**6,06**	W/m2.K
Buitenoppervlakte ongeisoleerde glijbaan:		188	m2
Thermisch verlies door buis buitenoppervlak:		97.572	kWhth/jaar
Aardgasverbruik ongeisoleerd:		11.700	m3/jaar
Geisoleerde buitenglijbaan op jaarbasis			
Dikte van isolatielaag:		0,15	m
Warmteweerstand van glijbaan plus isolatie Rc:		4,29	m2.K/W
Totale warmteweerstand Rτ (incl. Rse en Rsi):		4,43	m2.K/W
Warmtegeleidingscoëfficiënt geisoleerde glijbaan:		**0,23**	W/m2.K
Buitenoppervlakte geisoleerde glijbaan:		236	m2
Thermisch verlies door geisoleerde buisoppervlak:		4.543	kWhth/jaar
Aardgasverbruik geisoleerd:		550	m3/jaar
Aardgas en kostenbesparing per jaar door isolatie ingreep			
Geschatte aardgasbesparing:		11.150	m3/jaar
Geschatte aardgaskostenbesparing:		**€ 16.700**	euro/jaar