APPENDIX B

ECONOMIC ANALYSIS OF INSTALLATION OF INSULATION

Economic analysis is calculated based on the following assumptions

- insulation is applied on the back wall and front door only.
- temperature of insulator surface exposed to surroundings is 40 °C for 25 mm thickness insulation and decreases as thickness increases (see Table B.1)
- Measurement of back wall and door temperatures during energy auditing gave average surface temperatures as 43 °C and 45 °C, respectively.
- Smoking time, by average, is 133 hours.
- Each smoking room is operating at 50 times/year.
- By average, the firewood consumption is 5.5 m^3/room/batch and the firewoodprice is 100 Baht/m^3 (factory number 12 in Table 2.3)
- Alternatives for the insulation are given in Table B.1
- Current annual operating cost was estimated as

$$50 \ \frac{\text{smoking}}{\text{year}} \times 5.5 \ \frac{m^3}{\text{smoking}} \times 100 \ \frac{\text{Baht}}{m^3} = 27500 \ \frac{\text{Baht}}{\text{year}}$$

Table B.1 Insulations Selected for Economic Analysis.

Materials	Thickness@ (mm)	Cost+ (Baht)	Initial** Heat Loss (MJ)	ΔT (°C)		Heat Saved (MJ)	Money saved (Baht)
				Wall	Door		
Glass* Fibre	25	4416	226480	3	5	215752	5288
	50	8640	226480	2.5	4.5	221787	5436
	100	17280	226480	2	4	224469	5501
	150	25920	226480	1.5	3.5	225363	5523
	200	34560	226480	1	3	225809	5534

* Microfiber Industries Ltd., Bangkok

@ Commercial available only in 25 and 50 mm., 100 mm. thickness achieved by two layers of 50 mm and so on.

\+ Cost at 1991, installation cost is assumed to be 20% of material cost.

** From Table 3.2 for back wall and door x 50 (MJ/year).

Heat saved in Table B.1 is calculated by

$$Q = 226480 - \left\{ \Sigma \left(kA \frac{\Delta T}{\Delta X} \cdot \Delta t \right) \right\} \times n$$

Where k = Thermal conductivity of insulation = 0.0389 W/m.K

A = Area = 4.5x8 = 36 m^2

ΔT = Temperature difference of inner and outer surfaces of insulation

Δx = Thickness (see Table B.1)

Δt = Smoking time = 133 x 3600 sec

n = Number of operation = 50/year

Money saved was estimated from firewood price and heating value as 40.8 MJ/Baht

Economic analyses were carried out by Rate of Return Method and Simple Payback Method assuming life of 10 years. Results are shown in Table B.2.

Table B.2 Economic Analysis.

Insulation thickness (mm)	Annual save (Baht)	First cost (Baht)	USPW*	IRR	Simple Payback (year)
25	5288	4416	0.84	>50%	0.84
50	5436	8640	1.59	>50%	1.59
100	5501	17280	3.14	≃30%	3.14
150	5523	25920	4.69	≃17%	4.69
200	5534	34560	6.24	≃10%	6.24

* USPW = Uniform Series Present Worth = First cost/ Annual save.

Because the first cost is proportional to the thickness while the annual save slightly varies with the thickness, the minimum thickness gives the highest IRR. With IRR of more than 50%, this makes the application of thermal insulation feasible.