Determining the Source of Heat Loss in a SUNGLASSES, Inc. Distillation Column

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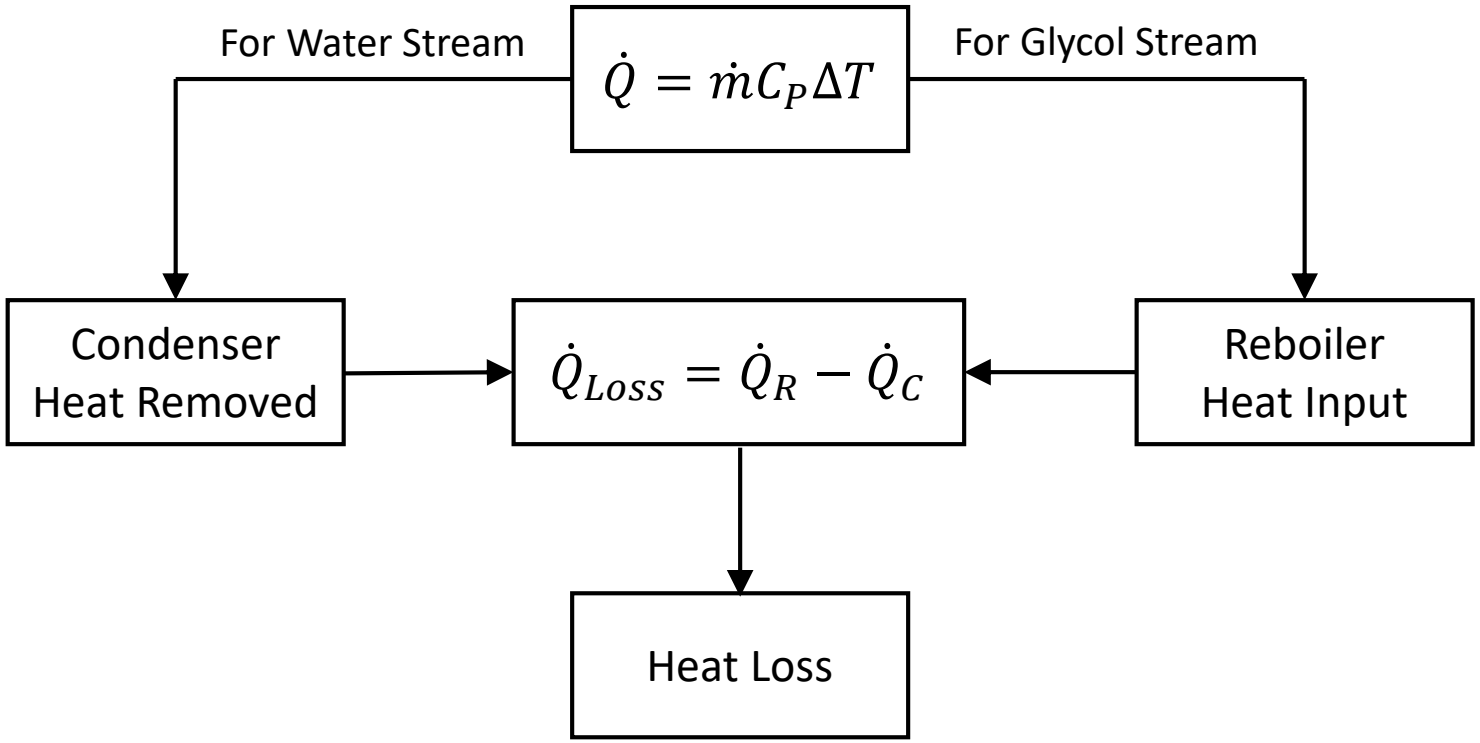
Consolidated Heat & Energy Advisory Professionals

Where Is the SUNGLASSES, Inc. Distillation Column Losing Heat?

CHEAP

To Answer this Question, Energy Balances were Performed on the Data



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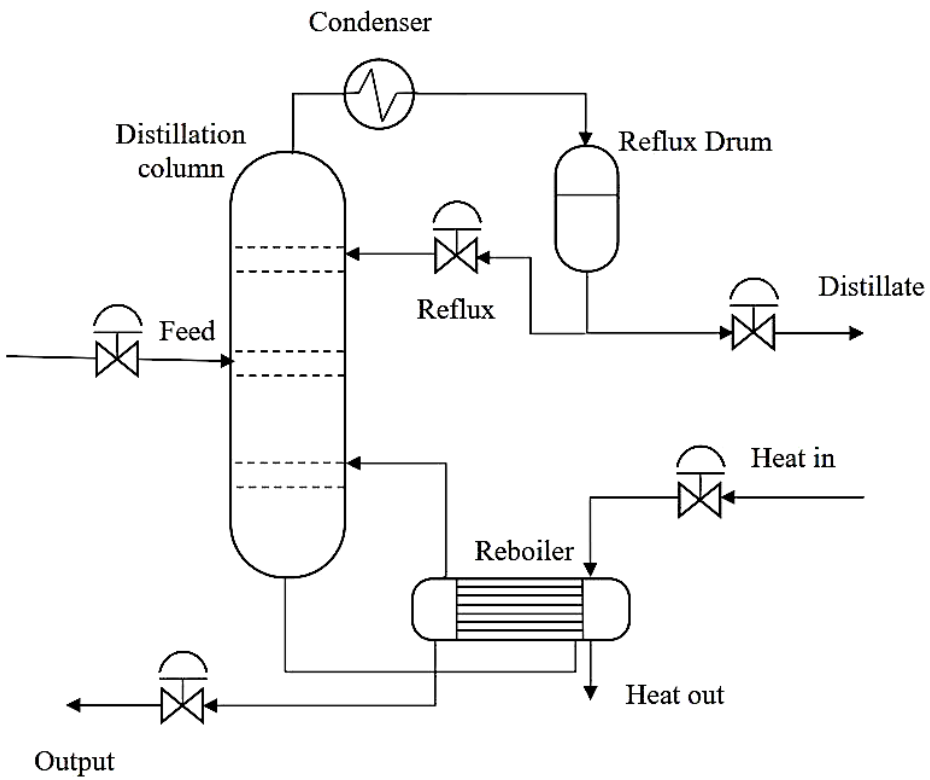
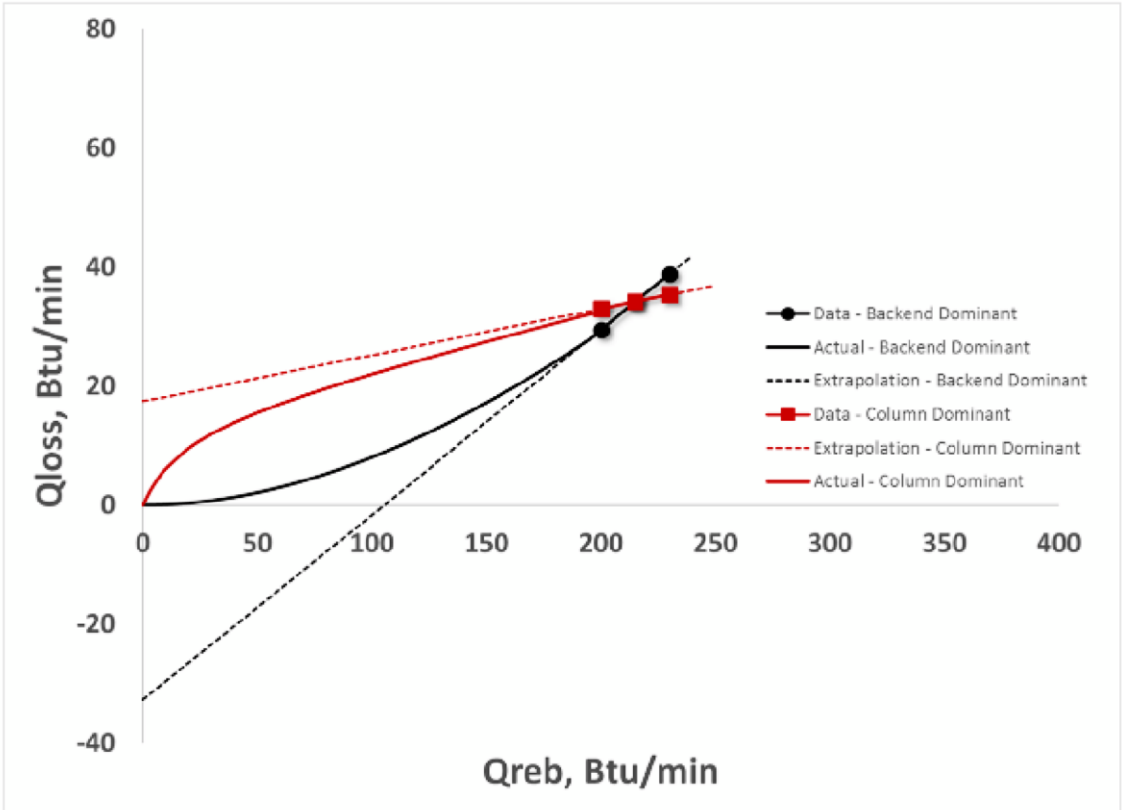
The Experiment Was Designed Such That the y-Intercept Indicates Where Heat Is Lost





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Uncertainty Was Estimated Using Monte Carlo Latin Hypercube Sampling

Total Reflux Trial Run 4 | Uncertainty: 95%		
Measured Variable	Value	Units
Mass of Water:	15 ± 0.008 kg	
Reboiler Heat Input:	180 ± 6 BTU/min	
Column Heat Loss:	[17 < (P = 24) < 32] BTU/min	

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Uncertainty Was Estimated Using Monte Carlo Sampling

Total Reflux Trial Run 4 | Uncertainty: 95%			**Total Reflux Trial Run 5 | Uncertainty: 95%**		
Measured Variable	Value	Units	Measured Variable	Value	Units
Mass of Water:	15 ± 0.008 kg		Mass of Water:	18 ± 0.011 kg	
Reboiler Heat Input:	180 ± 6 BTU/min		Reboiler Heat Input:	200 ± 6 BTU/min	
Column Heat Loss:	[17 < (P = 24) < 32] BTU/min		Column Heat Loss:	29 ± 8 BTU/min	
Total Reflux Trial Run 6 | Uncertainty: 95%			**Total Reflux Trial Run 9 | Uncertainty: 95%**		
Measured Variable	Value	Units	Measured Variable	Value	Units
Mass of Water:	21 ± 0.08 kg		Mass of Water:	16 ± 0.013 kg	
Reboiler Heat Input:	250 ± 7 BTU/min		Reboiler Heat Input:	170 ± 5 BTU/min	
Column Heat Loss:	44 ± 9 BTU/min		Column Heat Loss:	[13 < (P = 20) < 26] BTU/min	

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Uncertainty Was Estimated Using Monte Carlo Sampling

Total Reflux Trial Run 10 | Uncertainty: 95%			**Total Reflux Trial Run 11 | Uncertainty: 95%**		
Measured Variable	Value	Units	Measured Variable	Value	Units
Mass of Water:	18 ± 0.2 kg		Mass of Water:	20 ± 0.07 kg	
Reboiler Heat Input:	200 ± 6 BTU/min		Reboiler Heat Input:	240 ± 7 BTU/min	
Column Heat Loss:	26 ± 6 BTU/min		Column Heat Loss:	[34 < (P = 43) < 51] BTU/min	

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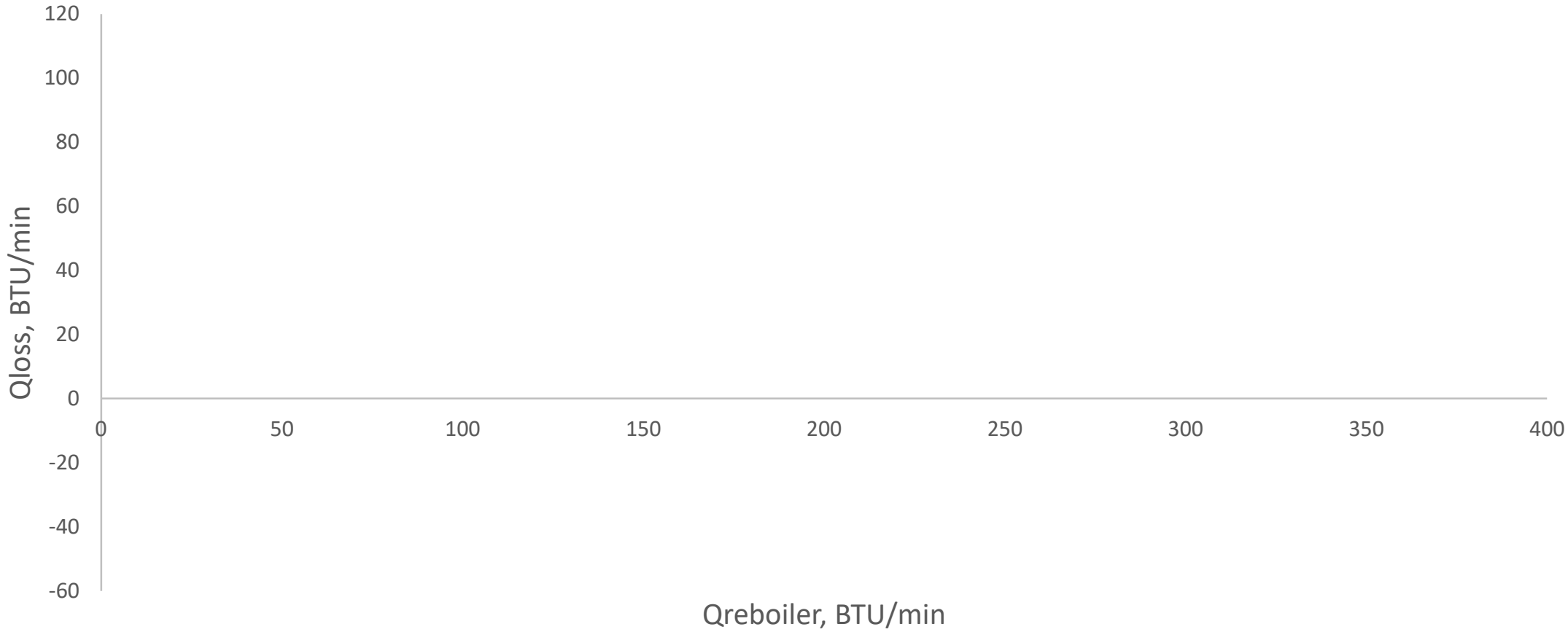
I Linearly Extrapolated These Data Plotting Heat Loss vs. Reboiler Heat Input



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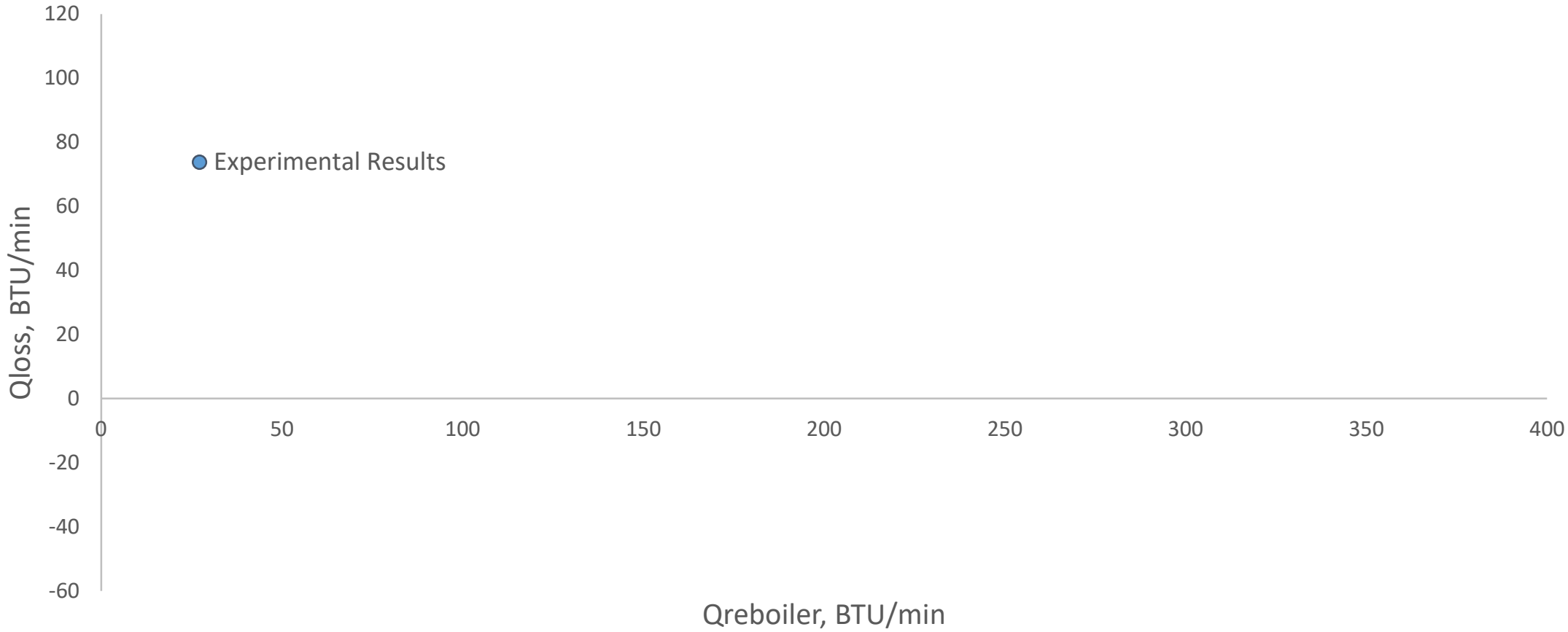

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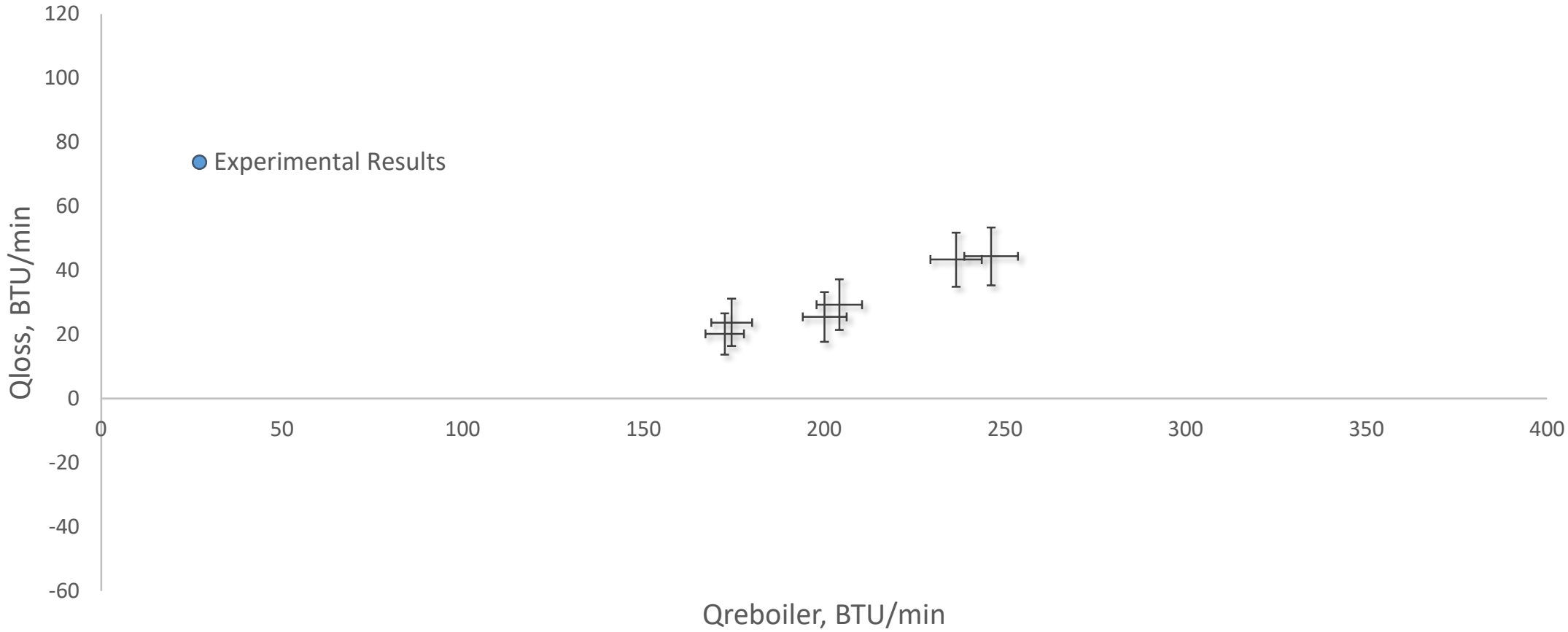

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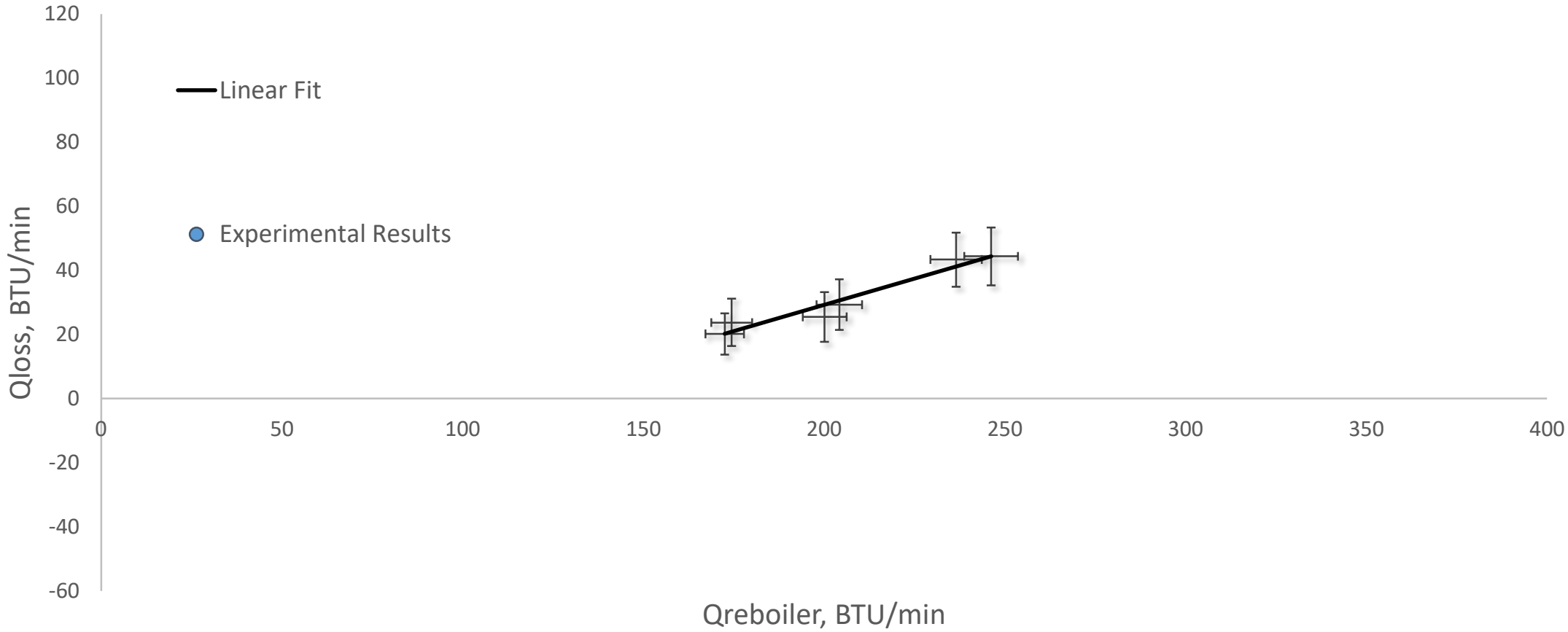

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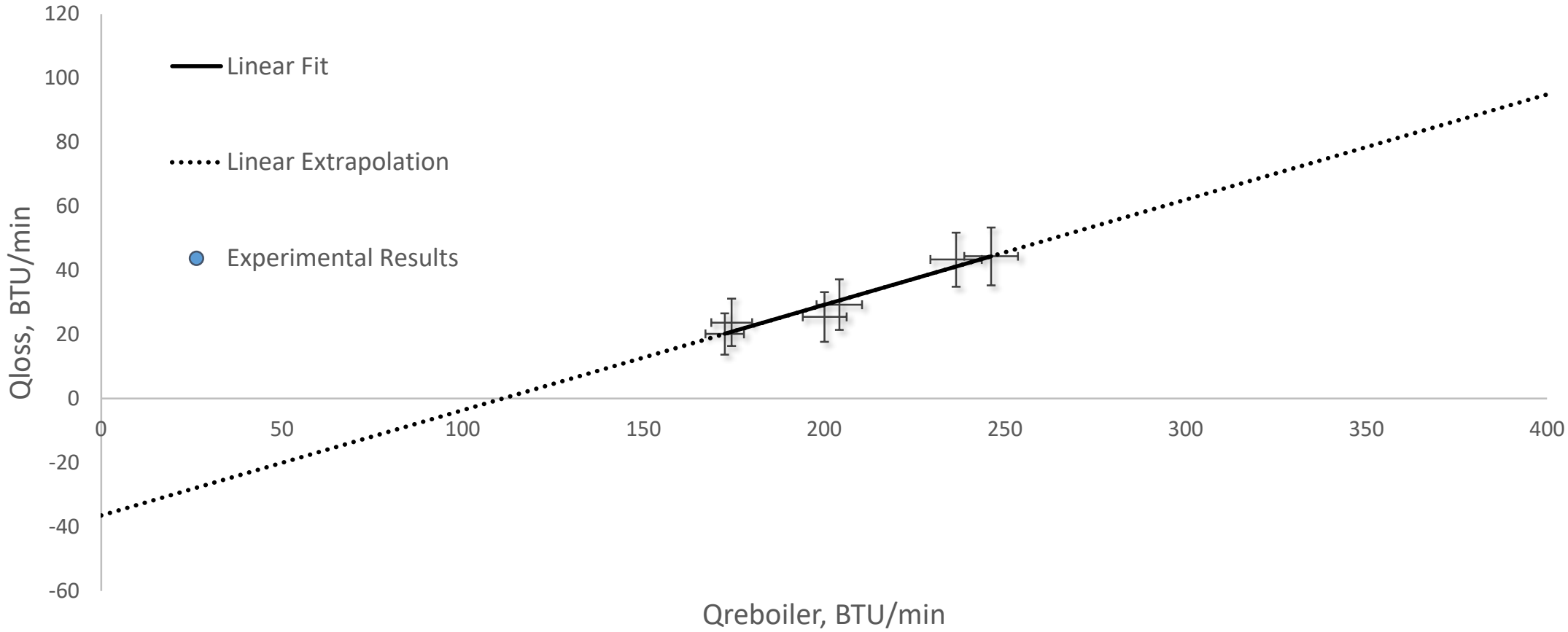
I Linearly Extrapolated These Data Plotting Heat Loss vs. Reboiler Heat Input



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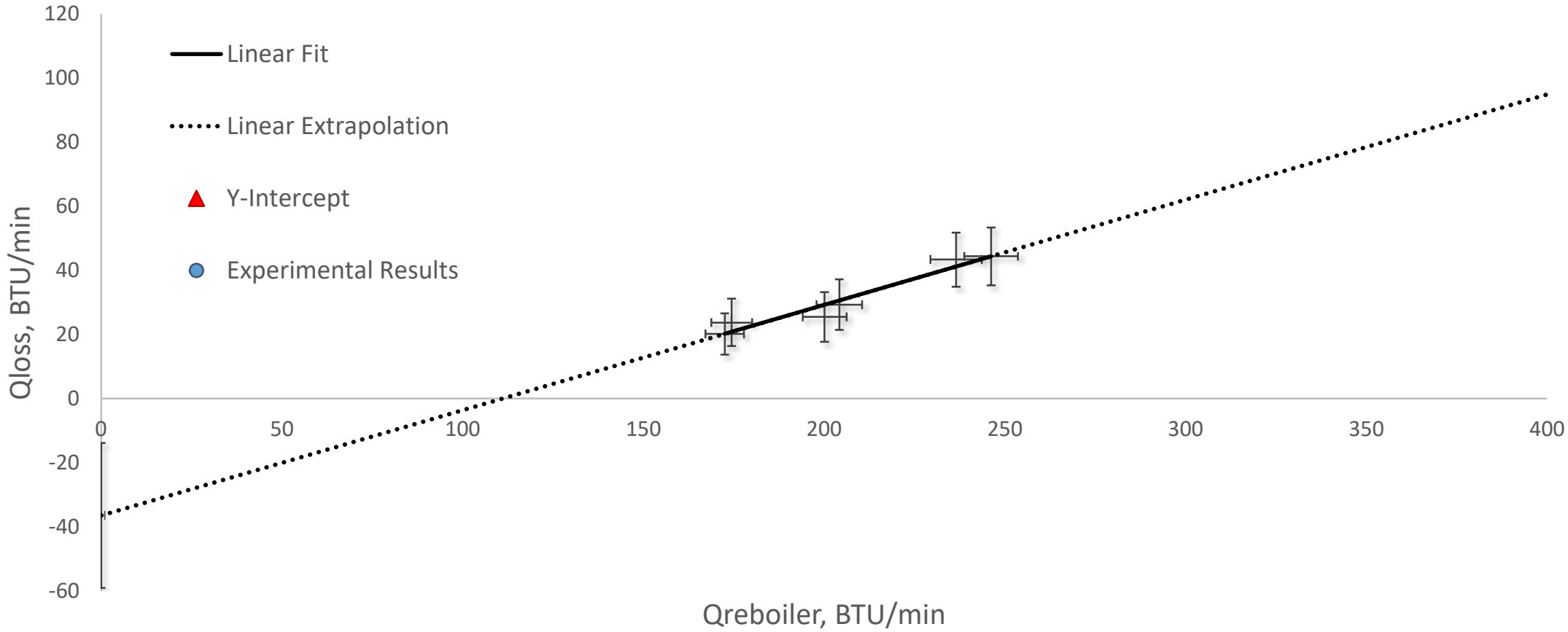

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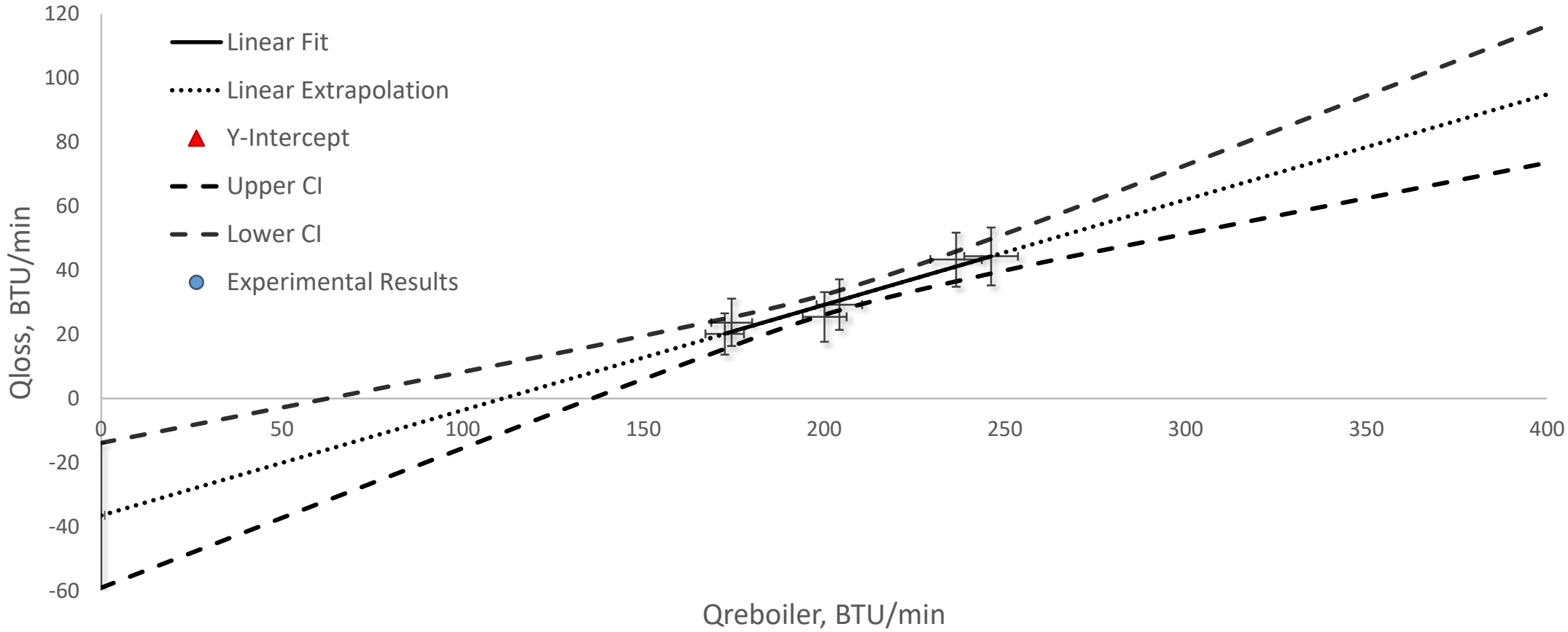
The y-Intercept for These Data Was Negative Suggesting That the Back-end Is the Source



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I Performed a Hypothesis Test on the Results and Rejected the Hull Hypothesis

$\mathbf{H_0}$: y-Int ≠ 0 $\mathbf{H_1}$: y-Int < 0	$\mathbf{t_0}$:-4.48 $\mathbf{-t_c}$:-2.13
$\mathbf{t_0 < -t_c}$:Yes	

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I Conclude with Certainty That the Column's Back-end Is Responsible for the Heat Loss

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My Recommendation is to Insulate the Column's Back-end

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