

Dylan Mark Rowley

Thesis submitted to the faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Master of Science

In

Mining and Minerals Engineering

Gerald H. Luttrell, Chair
Gregory T. Adel
Jaisen N. Kohmuench

June 6, 2014
Blacksburg, VA



Dylan Rowley <drowley0160@gmail.com>

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East, Deborah <Deborah.East@tandf.co.uk>
To: Dylan Rowley <drowley0160@gmail.com>

Tue, Jul 15, 2014 at 5:00 AM

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Subject: gmpr20: The Effect of Bubble Size on Fine Particle Flotation

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Town: madison

Postcode/ZIP code: 30650

Country: United States

Contact telephone number: 7068181587

Contact email address: drowley0160@gmail.com

Article title: The Effect of Bubble Size on Fine Particle Flotation

Article DOI: 10.1080/08827508908952646

Author name: R. H. YOON, G. H. LUTTRELL

Journal title: Mineral Processing and Extractive Metallurgy Review

Volume number: 5

Issue number: 1-4

Year of publication: 1989

Page number(s): 101-122

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Dylan Rowley <drowley0160@gmail.com>

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9 messages

Michele Lawrie-Munro <lawriemunro@aimehq.org>
To: "drowley0160@gmail.com" <drowley0160@gmail.com>

Fri, Jul 11, 2014 at 4:22 AM

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"Effect of particle size on flotation" by Gaudin, Volume 414 from 1931.

Michele

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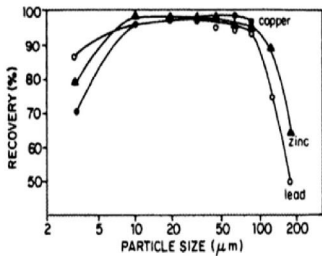
Dylan Rowley <drowley0160@gmail.com>
To: Michele Lawrie-Munro <lawriemunro@aimehq.org>

Fri, Jul 11, 2014 at 7:54 AM

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[Quoted text hidden]
Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

Michele Lawrie-Munro <lawriemunro@aimehq.org>
To: "kral@smenet.org" <kral@smenet.org>, "drowley0160@gmail.com" <drowley0160@gmail.com>

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From: Dylan Rowley [mailto:drowley0160@gmail.com]
Sent: Friday, July 11, 2014 5:55 AM
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Okay, sounds good. Thank you Michele. Just let me know what happens.

Dylan
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Steve Kral <kral@smenet.org>
 To: Michele Lawrie-Munro <lawriemunro@aimehq.org>, "Dylan Rowley" <drowley0160@gmail.com>

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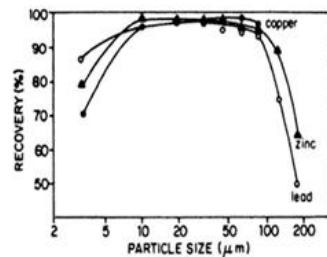
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Mesh Size	WOC	Ash Removal (Percent)			
		Single Stage Flotation	Air Sparged Hydrocyclone Unit		
			Illinois 6	Beaver Creek	Lower Kittinging
28x100	60-65	50-60	77-86	84.2	70.4
100x200	40-45	40-45	59-68	70.2	39.6
200x325	15-18	40-45	44-62	77	42.5
-325	0-5	50-55	57-67	81	54

Miller, J., Misra, M., & Gopalakrishnan, S. (1985). Fine Gold Flotation From Colorado River Sand with the Air Sparged Hydrocyclone. SME-AIME. Albuquerque: Society of Mining Engineers of AIME.

ASH Parameters		
Design Variables		
Cyclone Diameter	5	cm
Cyclone Length	52.5	cm
Pore Size	1	micron
Pedestal Diameter	4.25	cm
Operating Parameters		
Promoter	0.05	g/kg
Collector	0.08	g/kg
Frother	0.1	g/kg
Air Flow Rate	100	slpm
Solids Feed Rate	1	tph
Percent Solids	16	%

Comparison of Flotation Methods on Gold Ore						
	Air Sparged Hydrocyclone			Conventional Batch Flotation		
	Stream	Weight %	Grade	Recovery	Weight %	Grade
Concentrate	0.39	2.17	80.98	0.7	1.075	55.81
Tail	99.61	0.002	19.02	99.3	0.006	44.19
Feed	100	0.01	100	100	0.014	100

Thank you,

Dylan
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Dylan Rowley
Virginia Tech
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Steve Kral <kral@smenet.org>
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Operating Parameters		
Promoter	0.05	g/kg
Collector	0.08	g/kg
Frother	0.1	g/kg
Air Flow Rate	100	slpm
Solids Feed Rate	1	tph
Percent Solids	16	%

Comparison of Flotation Methods on Gold Ore

Stream	Air Sparged Hydrocyclone			Conventional Batch Flotation		
	Weight %	Grade	Recovery	Weight %	Grade	Recovery
Concentrate	0.39	2.17	80.98	0.7	1.075	55.81
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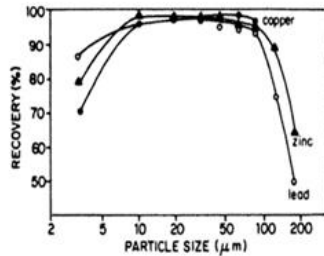
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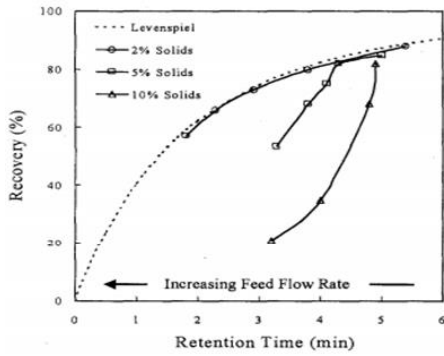
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Mon, Jul 14, 2014 at 10:05 AM

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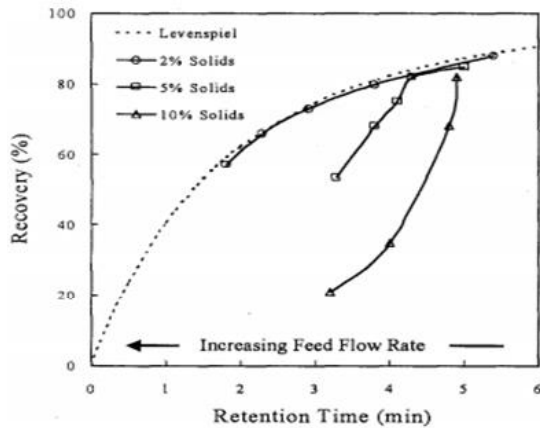
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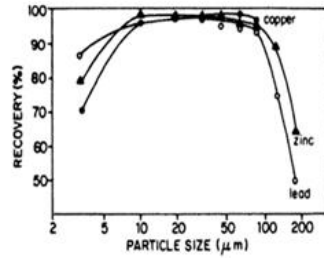
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Englewood, CO 80112
Email: lawriemunro@aimehq.org <<http://lawriemunro@aimehq.org>> <<http://lawriemunro@aimehq.org>>
Phone: 1-303-325-5185 <tel:1-303-325-5185> <tel:1-303-325-5185 <tel:1-303-325-5185>> <tel:1-303-325-5185 <tel:1-303-325-5185>> <tel:1-303-325-5185 <tel:1-303-325-5185>>>
Fax: 1-888-702-0049 <tel:1-888-702-0049> <tel:1-888-702-0049 <tel:1-888-702-0049>> <tel:1-888-702-0049 <tel:1-888-702-0049>>>
Website: www.aimehq.org <<http://www.aimehq.org>> <<http://www.aimehq.org>>
<<http://www.aimehq.org>>



Dylan Rowley <drowley0160@gmail.com>

DE/GCOP/P1611

1 message

East, Deborah <Deborah.East@tandf.co.uk>
To: Dylan Rowley <drowley0160@gmail.com>

Mon, Jul 14, 2014 at 4:52 AM

Our Ref: DE/GCOP/P1611

Date: 11th July 2014

Dear Dylan Rowley,

Thank you for your correspondence requesting permission to reproduce the following material from our Journal in your printed thesis at **Virginia Tech** entitled "**Investigation of Flash Flotation Technology Utilizing Centrifugal Forces and Novel Sparging Methods**" and to be posted in your university's repository.

Material Requested: 2 x Figures from - Assessment of the Controlling Factors in Turbo Flotation by Statistical Analysis – Coal Preparation – Volume 21 Issue 4 PP 355-382 – Authors – P. K. Ofori, B. A. Firth & T. Howes

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Yours sincerely

Debbie East.

Debbie East- Permissions & Licence Administrator - Journals.

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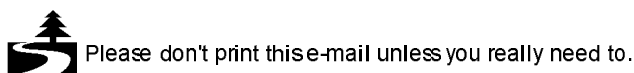
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From: Dylan Rowley [<mailto:drowley0160@gmail.com>]

Sent: 11 July 2014 15:28

To: East, Deborah

Subject: Re: gcop19:Assessment of the Controlling Factors in Turbo Flotation by Statistical Analysis

I attend Virginia Tech and the title of my thesis is "Investigation of Flash Flotation Technology Utilizing

Centrifugal Forces and Novel Sparging Methods". Do you need any other sort of proof that I attend? Please let me know. Thank you.

Dylan

On Fri, Jul 11, 2014 at 10:25 AM, East, Deborah <Deborah.East@tandf.co.uk> wrote:

Dear Dylan, Please can I ask you to confirm if this is for your thesis ? if so can you please confirm your University that you attend and also confirm your Thesis title.

Thank you and kindest regards

Debbie East.

Debbie East– Permissions & Licence Administrator - Journals.

Routledge, Taylor & Francis Group.

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Tel :+44(0)20 7017 6960

Fax: +44 (0)20 7017 6336

Web: www.tandfonline.com

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Please don't print this e-mail unless you really need to.

From: Dylan Rowley [mailto:drowley0160@gmail.com]
Sent: 11 July 2014 13:35
To: Academic UK Non Rightslink
Subject: gcop19:Assessment of the Controlling Factors in Turbo Flotation by Statistical Analysis

Permissions Request

Contact name: Dylan Rowley

Street address: 1781 old buckhead rd

Town: Madison

Postcode/ZIP code: 30650

Country: United States

Contact telephone number: 7068181587

Contact email address: drowley0160@gmail.com

Article title: Assessment of the Controlling Factors in Turbo Flotation by Statistical Analysis

Article DOI: 10.1080/07349340008945626

Author name: P. K. OFORI, B. A. FIRTH, T. HOWES

Journal title: Coal Preparation

Volume number: 21

Issue number: 4

Year of publication: 2000

Page number(s): 355-382

Are you the sole author/editor of the new publication?: No

Are you requesting the full article?: No

If no, please supply extract and include number of word:

If no, please supply details of figure/table: I am requesting use of two figures. The first figure is a diagram of the Turbo Flotation System. The second is a the Yield vs. Ash graph where Ofori compares the Turbo Flotation results to traditional flotation techniques.

Name of publisher of new publication: Virginia Tech

Title of new publication: Investigation of Flash Flotation Technology Utilizing Centrifugal Forces and Novel Sparging Methods

Course pack: No

Number of Students:

Is print:

Electronic: Yes

E-reserve: No

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Thesis: Yes

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--
Dylan Rowley
Virginia Tech
Mining and Minerals Engineering



Dylan Rowley <drowley0160@gmail.com>

FLSmidth Image Permission

7 messages

Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>
To: "drowley0160@gmail.com" <drowley0160@gmail.com>
Cc: Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>

Thu, Jul 10, 2014 at 1:09 PM

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Thank you and regards,

Andrew Cuthbert
Director - Global Marketing, Minerals

Direct +1 801 871 7105
andrew.cuthbert@flsmidth.com

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Dylan Rowley <drowley0160@gmail.com>
To: Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>

Thu, Jul 10, 2014 at 1:27 PM

Hi Andrew,

Thank you for the form. I just found another FL Smidth picture I used for the same purpose. It is a picture of a Krebs Hydrocyclone and it is cut in half to show what happens inside the hydrocyclone. I do not have a source for it as I found it through the internet but could not find it on your website. Would I need to fill out two separate forms or just complete one form and return it to you.

Thank you for your help.

Dylan

[Quoted text hidden]

--

Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>
To: Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 1:38 PM

One form is fine. Thanks,

Andrew Cuthbert
Director - Global Marketing, Minerals

Direct +1 801 871 7105 · Mobile +1 801 647 4772
andrew.cuthbert@flsmidth.com

FLSmidth
FLSmidth USA Inc. · Salt Lake City Operations

7158 S. FLSmidth Drive · Midvale, UT 84047-5559 · USA

Tel +1 801 871 7000 · Fax +1 801 871 7001

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From: Dylan Rowley [mailto:drowley0160@gmail.com]
Sent: Thursday, July 10, 2014 11:27 AM
To: Andrew Cuthbert
Subject: Re: FLSmidth Image Permission

[Quoted text hidden]

Dylan Rowley <drowley0160@gmail.com>
To: Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>

Thu, Jul 10, 2014 at 2:36 PM

Andrew,

Attached is the form filled out and signed. Let me know if I need to include or redo anything.

Thank you,

Dylan

On Thu, Jul 10, 2014 at 1:09 PM, Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com> wrote:
[Quoted text hidden]

--
Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

 **Rowley, Dylan Copyright Use.pdf**
294K

Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>
To: Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 2:38 PM

Perfect. Thanks. Good luck with your thesis.

Andrew Cuthbert
Director - Global Marketing, Minerals

Direct +1 801 871 7105
andrew.cuthbert@flsmidth.com

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From: Dylan Rowley [mailto:drowley0160@gmail.com]
Sent: Thursday, July 10, 2014 12:36 PM
To: Andrew Cuthbert
Subject: Re: FLSmidth Image Permission

Andrew,

[Quoted text hidden]

[Quoted text hidden]

Dylan Rowley <drowley0160@gmail.com>
To: Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>

Thu, Jul 10, 2014 at 2:51 PM

Thank you Andrew! Greatly appreciate your help. When can I expect back the signed form?

Dylan

[Quoted text hidden]

Andrew Cuthbert <Andrew.Cuthbert@flsmidth.com>
To: Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 4:12 PM

Here you go.

Andrew Cuthbert

Director - Global Marketing, Minerals

Direct +1 801 871 7105
andrew.cuthbert@flsmidth.com

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From: Dylan Rowley [mailto:drowley0160@gmail.com]

Sent: Thursday, July 10, 2014 12:52 PM

[Quoted text hidden]

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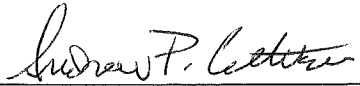
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"*Purpose*" shall mean: Flotation & Hydrocyclone separation explanations for Virginia Tech Thesis

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Authorized Signature 

Name ANDREW CUTHBERT

Title DIRECTOR - GLOBAL MARKETING

GRANTEE

Authorized Signature 

Name Dylan Rowley

Title Graduate Research Assistant

Company Virginia Tech - Mining and Minerals Dept.

Country United States



Dylan Rowley <drowley0160@gmail.com>

Dylan Rowley: Copyright Permission SME Handbook

7 messages

Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 12:28 PM

To: olivier@smenet.org

Hi Jane,

We just spoke on the phone about the copyright for the SME Handbook. I used the images of a flotation cell in the "Fundamental Principles of Froth Flotation" by Kawatra, S.K. The pages I have listed for the section are 1517-1531. Thank you for your help.

Very Respectfully,

--

Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

Jane Olivier <glacierpublishing@gmail.com>

Thu, Jul 10, 2014 at 2:31 PM

To: Dylan Rowley <drowley0160@gmail.com>

Hello Dylan,

Thank you for contacting SME about permission to repurpose the copyrighted figures from the SME Mining Engineering Handbook.

You are hereby authorized to do so providing you include a complete source line for each figure, citing the Handbook and including SME's web address: smenet.org

Regards,
Jane Olivier
Manager of Book Publishing
SME

[Quoted text hidden]

Dylan Rowley <drowley0160@gmail.com>

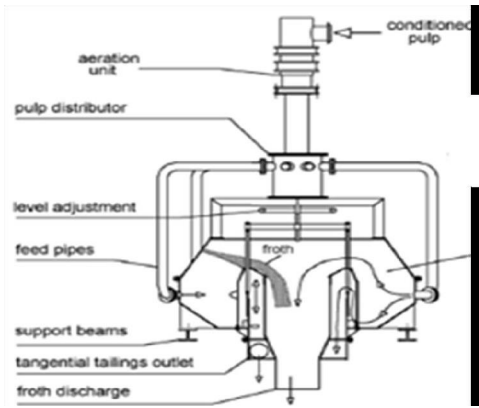
Thu, Jul 10, 2014 at 2:41 PM

To: Jane Olivier <glacierpublishing@gmail.com>

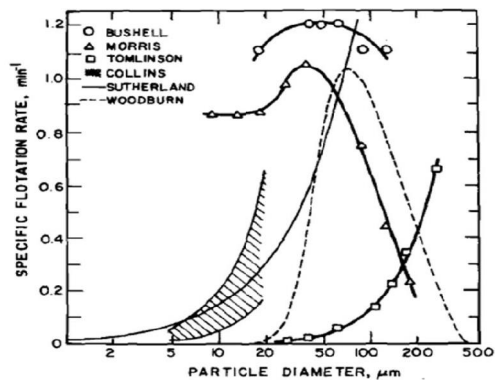
Hi Jane,

Thank you very much! I came across to other figures I am using in my thesis that are part of SME publications. I am including the citations below with their associated figure. I am requesting copyright permission on those as well.

Battersby, M., Brown, J., & Imhof, R. (2003). The Imhoflot G-Cell - An Advanced Pneumatic Flotation Technology for the Recovery of Coal Slurry From Impoundments. Cincinnati: Society for Mining, Metallurgy, and Exploration.



Fuerstenau, D. (1980). Fine Particle Flotation. In P. Somasundara, Fine Particles Processing (p. 671). SME-AIME.



Let me know if I can use these images or if we have to go about it a different way.

Thank you very much

Dylan Rowley

[Quoted text hidden]

Jane Olivier <glacierpublishing@gmail.com>
To: Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 2:52 PM

On behalf of SME, I hereby authorize the reuse of the additional two figures. Again, please include a complete citation.

Best,
Jane

On Jul 10, 2014, at 12:41 PM, Dylan Rowley <drowley0160@gmail.com> wrote:

Hi Jane,

Thank you very much! I came across to other figures I am using in my thesis that are part of SME publications. I am including the citations below with their associated figure. I am requesting copyright permission on those as well.

Battersby, M., Brown, J., & Imhof, R. (2003). The Imhoflot G-Cell - An Advanced Pneumatic Flotation Technology for the Recovery of Coal Slurry From Impoundments. Cincinnati: Society for

Mining, Metallurgy, and Exploration.

<image.png>

Fuerstenau, D. (1980). Fine Particle Flotation. In P. Somasundara, Fine Particles Processing (p. 671). SME-AIME.

<image.png>

Let me know if I can use these images or if we have to go about it a different way.

Thank you very much

Dylan Rowley

On Thu, Jul 10, 2014 at 2:31 PM, Jane Olivier <glacierpublishing@gmail.com> wrote:

Hello Dylan,

Thank you for contacting SME about permission to repurpose the copyrighted figures from the SME Mining Engineering Handbook.

You are hereby authorized to do so providing you include a complete source line for each figure, citing the Handbook and including SME's web address: smenet.org

Regards,
Jane Olivier
Manager of Book Publishing
SME

On Jul 10, 2014, at 10:28 AM, Dylan Rowley <drowley0160@gmail.com> wrote:

> Hi Jane,
>

> We just spoke on the phone about the copyright for the SME Handbook. I used the images of a flotation cell in the "Fundamental Principles of Froth Flotation" by Kawatra, S.K. The pages I have listed for the section are 1517-1531. Thank you for your help.

>
> Very Respectfully,
>
> --
> Dylan Rowley
> Virginia Tech
> Mining and Minerals Engineering

--

Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

Dylan Rowley <drowley0160@gmail.com>
To: Jane Olivier <glacierpublishing@gmail.com>

Thu, Jul 10, 2014 at 2:53 PM

Awesome! Thank you Jane. I greatly appreciate your help!

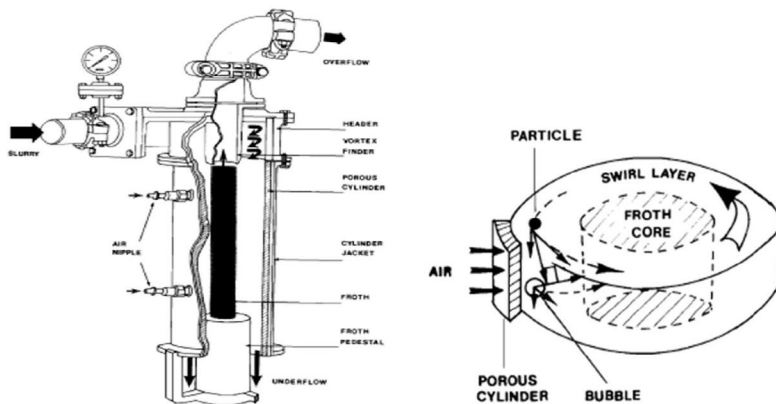
[Quoted text hidden]

Dylan Rowley <drowley0160@gmail.com>
To: Jane Olivier <glacierpublishing@gmail.com>

Thu, Jul 10, 2014 at 3:46 PM

I apologize Jane for overrunning you with emails about copyright permission. I should have collected them all at once. I do have two more figures. The citation and pictures are shown below.

Ye, Y., Gopalakrishnan, S., Pacquet, E., & Miller, J. (1988). Development of the Air Sparged Hydrocyclone - A Swirl-Flow Flotation Column. Column Flotation '88 - Proceedings of an International Symposium (p. 9). Denver: SME.



I apologize again. Thank you.

Dylan
[Quoted text hidden]

Jane Olivier <glacierpublishing@gmail.com>
To: Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 3:48 PM

These too are authorized.

I must tell you though that you have reached the limit on the number of figures we allow to be repurposed, especially at no cost.

Hopefully there are no more.

On Jul 10, 2014, at 1:46 PM, Dylan Rowley <drowley0160@gmail.com> wrote:

I apologize Jane for overrunning you with emails about copyright permission. I should have collected them all at once. I do have two more figures. The citation and pictures are shown below.

Ye, Y., Gopalakrishnan, S., Pacquet, E., & Miller, J. (1988). Development of the Air Sparged Hydrocyclone - A Swirl-Flow Flotation Column. Column Flotation '88 - Proceedings of an

International Symposium (p. 9). Denver: SME.

<image.png> <image.png>

[Quoted text hidden]

[Quoted text hidden]



Dylan Rowley <drowley0160@gmail.com>

Dylan Rowley: Cavitation Tube Figure Permission

2 messages

Dylan Rowley <drowley0160@gmail.com>

Thu, Jul 10, 2014 at 1:07 PM

To: jkohmuench@eriez.com

Good Afternoon Jaisen,

I am requesting your copyright permission to use a figure of the cavitation tube in my thesis. The picture is shown below. Thank you.



--

Dylan Rowley
Virginia Tech
Mining and Minerals Engineering

Kohmuench, Jaisen <jkohmuench@eriez.com>

Thu, Jul 10, 2014 at 1:14 PM

To: Dylan Rowley <drowley0160@gmail.com>

Granted.

-Jaisen

Jaisen Kohmuench

Deputy Managing Director

Eriez Flotation Division|USA

2200 Asbury Road

Erie, PA 16506

Office: (814) 520-8428

Cell: (814) 746-5559



*****PLEASE NOTE MY NEW OFFICE PHONE NUMBER*****

From: Dylan Rowley [mailto:drowley0160@gmail.com]
Sent: Thursday, July 10, 2014 1:07 PM
To: Kohmuench, Jaisen
Subject: Dylan Rowley: Cavitation Tube Figure Permission

[Quoted text hidden]



Dylan Rowley <drowley0160@gmail.com>

Re: Dylan Rowley: Copyright Permission

2 messages

Aaron Noble <aaron.noble@mail.wvu.edu>
To: DYLAN <drowley0160@hotmail.com>

Thu, Jul 10, 2014 at 12:05 PM

Dylan,

I have no problem with you using my graph in your thesis as long as it is properly cited. I am glad that it helps.

Take care,

Dr. Aaron Noble
Assistant Professor
Mining Engineering || West Virginia University
(304) 293-9959 || canoble@mail.wvu.edu
353A Mineral Resources Building

On Wed, Jul 9, 2014 at 2:33 PM, DYLAN <drowley0160@hotmail.com> wrote:

Good Afternoon Aaron,

In my final thesis, I used your graph showing the increase in cell volume size over the years. I am requesting your permission to officially use it when I submit my thesis. Thank you.

Very Respectfully,

Dylan Rowley

Dylan Rowley <drowley0160@gmail.com>
To: Aaron Noble <aaron.noble@mail.wvu.edu>

Thu, Jul 10, 2014 at 12:06 PM

Thank you Aaron!

[Quoted text hidden]

-

Dylan Rowley
Virginia Tech
Mining and Minerals Engineering



Dylan Rowley <drowley0160@gmail.com>

Dylan Rowley: Permission to Use CAD Drawing

2 messages

Dylan Rowley <drowley0160@gmail.com>

Mon, Jul 7, 2014 at 3:12 PM

To: "Yan, Eric" <eyan@eriez.com>

Good Afternoon Eric,

I hope everything is going well. I am in the final stages of finishing my thesis and I am using the drawing of the first flotation cyclone you designed. I am requesting your permission to use said drawing in my thesis. The picture is included for your reference. Let me know if I can use it. Thank you.



Very Respectfully,

Dylan Rowley

Yan, Eric <eyan@eriez.com>

Mon, Jul 7, 2014 at 3:37 PM

To: Dylan Rowley <drowley0160@gmail.com>

Dylan,

Please do and let me know if you need any other documentation. I wish you the BEST luck!!

-eric

From: Dylan Rowley [mailto:drowley0160@gmail.com]**Sent:** Monday, July 07, 2014 3:12 PM**To:** Yan, Eric**Subject:** Dylan Rowley: Permission to Use CAD Drawing

[Quoted text hidden]

Draft 09/01/2009

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Name: Dylan Rowley

Description of item under review for fair use: Figure 1.2 Thermodynamic Description of Particle Bubble Attachment Yoon, R. (2011). Froth Flotation: Thermodynamics of Flotation. Blacksburg, Virginia.

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