



# Control of the risk of dyke failure caused by contact erosion

# **<u>Rémi Beguin</u><sup>1</sup>, J.-J. Fry<sup>2</sup>, C. Picault<sup>3</sup>, J.-R. Courivaud<sup>2</sup>, Y.-H. Faure<sup>4</sup>, P. Philippe<sup>5</sup>**

<sup>1</sup>geophyConsult, Bourget-du-Lac, France
 <sup>2</sup>eDF-CIH, Bourget-du-Lac, France
 <sup>3</sup>Compagnie Nationale du Rhône, Lyon, France
 <sup>4</sup>LTHE - Grenoble University, France
 <sup>5</sup>IRSTEA Aix-en-Provence, France

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**yeoph** 

#### 1. <u>Contact erosion problematic</u>

2. First large scale test program (2010-11) : Main results and conclusions

3. <u>Second large scale test program (2012) :</u> *Results of the first experiment* 

4. Conclusions and perspectives

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ICSE-6 : "Control of the risk of dyke failure caused by contact erosion"

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#### • <u>Objectives</u>

• Study the scale effect on the contact erosion process

- What will be the **consequences** of the development of contact erosion on the structure stability ?
- What are the best methods to detect contact erosion?



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#### <u>Scheme and instrumentation</u>



• Base layer : Gravel  $(20/40 \text{ mm}, \text{Cu}^1=1,5)$ 

• Core : Silty-Sand ( $d_{50} = 0,19 \text{ mm}, \text{Cu}^1=25$ )

<sup>1</sup>Cu : Coefficient of uniformity :  $d_{60}/d_{10}$ 

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• Pipe formation and propagation for 4 tests out of 5 conducted with this geometry







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Test n°6

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## **Objectives :**

 Experiment shell geometry and material grading more similar to Rhône and Rhine dike sections

Can the erosion process be control by the gravelly shell ?

• Understand the shell failure mechanism

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#### Reinforced shell: 1,3m thick and made of a mix of sand and gravels



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• Reinforced monitoring : 30 new interstitial pressure data logger

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 Evolution of the main parameters during the <sup>14</sup> test



Artificial burst of turbidity due to the manual collect of the deposited sediment in the downstream reservoir

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 Evolution of the main parameters during the <sup>15</sup> test



↓ : Artificial burst of turbidity due to the manual collect of the deposited sediment in the downstream reservoir

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.5 Result ~



#### Upstream tank



Downstream tank Top view



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## Signs of a pipe formation and propagation :

- Leakage flow-rate increase
- Interstitial pressure increase
- $\circ$  Total eroded estimated mass ~ 1000 kg
- High deformation of the core detected

#### Hopefully:

- After 20 hrs, decrease of the leakage flow-rate and the pore pressure
- Finally, the shell remained stable and the experiment was stopped after 95 h at the maximum hydraulic head

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• The 2010/11 campaign demonstrates the possibility of a **pipe formation** due to contact erosion initiation.

- This pipe formation lead to the **failure of the shell** in a few hours for 4 tests out of 5.
- A new test during the 2012 campaign concluded that the use of a **thicker shell** made of a **widely graded** soil enables to **control the pipe progression**, at least for some days, and preserve the structure stability.

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• Two new large scale tests are planned in 2012 and will give more data to confirm, or not, the results of this first test.

- We expect to determine rules for the **dike stability** based on:
  - the **global uplift** stability of the shell (after clogging),
  - the local stability of shell particles when the shell is submitted to a large leakage.

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... thanks you for your attention...

... and is looking forward to hearing your questions...

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## • Large-scale contact erosion tests :

Rémi Beguin (remi.beguin@geophyConsult.com)

## • <u>Headquarters and Fibre Optics Surveillance</u> <u>department</u>

- ✓ administration@geophy*Consult*.com
- ✓ Bât. Passerelle 6 30, allée du Lac d'Aiguebelette B.P.
  231 73 374 Le Bourget-du-Lac cedex France
- ✓ Tel. VoIP : +33 9 51 67 61 37
- ✓ Fax : +33 9 58 04 83 53

## • Erosion Tests Laboratory

- Patrick Pinettes (pinettes@geophyConsult.com)
- Sup'Agro geophy Consult SAS 2, place P. Viala 34 060 Montpellier cedex 2 – France
- ✓ Mob. : +33 6 85 81 79 68
- ✓ Tel. : +33 4 99 61 29 49
- ✓ Fax : +33 9 58 04 83 53

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#### Sample scale contact erosion tests





#### • Observation of pipe initiation at the granular interface



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## Shell grading curve D50~12mm Cu~30



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Titre de la présentation

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