AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 — AQUAEXCEL2020

# D4.4a Face-to-face training course1

*Wageningen University/AquaTT*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652831. This publication reflects only the view of the author, and the European Commission cannot be held responsible for any use which may be made of the information contained therein

# Executive Summary

**Objectives**
To educate a new generation of aquaculture researchers and industry stakeholders who focus on sustainable exploitation of their new knowledge, skills and tools to advance an innovative European aquaculture sector. The set-up of the training courses will centre on fostering a culture of cooperation between all parties involved.

**Rationale:**
To foster and build the human capital of the European aquaculture sector, several goals are set by the Strategic Research and Innovation Agenda of EATiP to which AQUAEXCEL2020 will contribute. All AQUAEXCEL2020 training courses are multi-partner collaborations bringing together unique knowledge, tools and skills to create innovative modules that promote and enable peer-to-peer networking and collaboration. Participative training design ensures exchange and mutual learning between trainers and participants from both academia and industry. New models and partnerships for learning are explored for future recurrence, encouraging career development and innovation in the sector. Access to Research Infrastructures (knowledge, facilities and experience) will add value to the training. The training courses are state-of-the-art, transferring new knowledge and insights originating from the research and services carried out and created by AQUAEXCEL2020, and building upon outputs, tools and achievements from FP7-AQUAEXCEL.

**Main Results:**
The second AQUAEXCEL2020 training course “Recirculating Aquaculture Systems (RAS) Technology” was the first face-to-face course and was provided by Ifremer, France in collaboration with Wageningen University (WU), The Netherlands. The objectives of this course were to review the basics of RAS and examine the different systems, designs, operations and applications. This second training course of the AQUAEXCEL2020 training courses took place in October 2016 with 27 participants who were selected based on their submitted applications. The course included lectures, practical design exercises and technical visits. Additionally, a half day industry mini seminar on RAS evolution and new RAS uses, involving RAS farmers and engineering companies, gave the course participants an opportunity to exchange with industry professionals. This RAS Industry mini seminar was also open to industry stakeholders not enrolled in the entire course to hear about the latest discussions and scientific advances in the RAS sector, and exchange with the course participants to gain information on RAS development and needs for sustainable development in other countries within and outside the EU.

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# 1. Introduction

AQUAEXCEL2020 aims to foster a culture of cooperation between European aquaculture Research Infrastructures (RIs), the associated research community, the aquaculture industry and other relevant stakeholders, which will help develop a more efficient and attractive European aquaculture Research Area leading to a sustainable and globally competitive European aquaculture sector. One of AQUAEXCEL2020's specific aims is to provide state-of-the-art unique training courses to educate a new generation of aquaculture researchers and industry stakeholders who focus on sustainable exploitation of their new knowledge, skills and tools to advance an innovative European aquaculture sector. Work package 4 of AQUAEXCEL2020 has a dedicated task focused on training a new generation of aquaculture researchers and industry stakeholders.

Nine technical training courses in total will be organised by different AQUAEXCEL2020 partners offered to people within and outside the partnership. The courses will focus on different aspects of aquaculture experimentation to foster a culture of cooperation between all parties involved. These training sessions will transfer new knowledge and insights originating from the research and services carried out and created by AQUAEXCEL2020.

This AQUAEXCEL2020 training course which was held on "Recirculating Aquaculture Systems (RAS) Technology" was a five-day face-to-face course with the objectives to review the basics of RAS and examine the different systems, designs, operations and applications.

RAS technology was developed in the 1980s, but its use in aquaculture remained quite limited. In Europe, it was used to produce 20 to 30% of the fish fingerlings. There is a limited availability of freshwater which can be used for the production of salmon smolt. Therefore, the necessity to save freshwater, coupled with i) the necessity to increase fish health and safety in the salmon ongrowing industry by reducing the use of chemicals, and ii) the progressive enforcement of EU water quality regulations, has transformed RAS technology into a key method to develop and advance aquaculture production. This has led to increased training needs on RAS technology in the industry.

In total 11 tutors contributed to the training course (see also Annex 4). Seven tutors are working in research institutes which are partners in the AE2020 consortium (Ifremer, WU, INRA, Nofima and Sintef).

This RAS training course included: i) basics of RAS, ii) design and management of RAS and examples, iii) sustainability, waste treatment and valorisation as well as iv) technical visits. The course included lectures, practical design exercises and technical visits. Additionally, a half day industry mini seminar on RAS evolution and new RAS uses, involving RAS farmers and engineering companies, gave the course participants an opportunity to exchange with industry professionals.

This RAS Industry mini seminar was also open to industry stakeholders not enrolled in the entire course to hear about the latest discussions and scientific advances in the RAS sector, and exchange with the course participants to gain information on RAS development and needs for sustainable development in other countries within and outside the EU.

# 2. Face-to-face course 1

## *2.1 Pre-course activities*

A promotional leaflet to promote the Training Course "Recirculating Aquaculture Systems (RAS) Technology" was developed (Figure 1) and distributed through several channels such as AquaTT Training News (monthly newsletter reaching over 3,000 people, many of which are in the aquaculture sector), European Aquaculture Society (EAS) distribution channels, Federation of European Aquaculture Producers (FEAP) and European Aquaculture Technology and Innovation Platform (EATiP) distribution channels, EuroMarine (a European marine science network), the project website (Figure 2), social media and the partner's channels. Annex I shows the promotional leaflet to promote the first course.


Figure 1. Promotional leaflet for RAS course

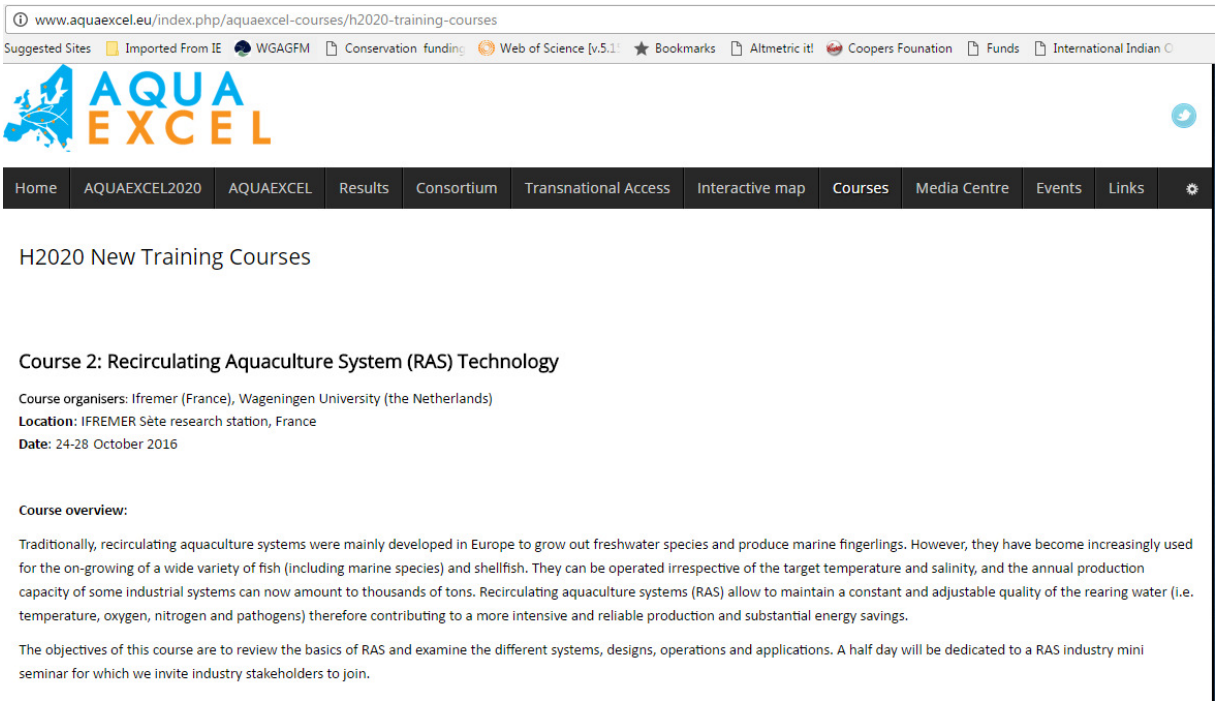


Figure 2. Print screen promotion of course on website – http://www.aquaexcel.eu/index.php/aquaexcel-courses/h2020-training-courses

The application period of the course was open from 29 July 2016 until 9 September 2016 and applicants were required to complete a registration form (Annex 2), a statement of motivation and email both, together with their CV to aquaexcel@aquatt.ie.

The target audience was aquaculture professionals with a university degree (e.g. engineers, researchers, etc.) interested in the potential applications of RAS (i.e. controlled intensive fish farming, water reuse, use of environmentally friendly technologies, etc.). Interested industry stakeholders not involved in the full course were welcome to take part in the industry mini seminar only.

Forty-eight individuals applied to participate in the training course with a maximum number of 30 participants practically possible. Therefore, a selection procedure was put in place by Ifremer and Wageningen University evaluating applicants based on their CVs and motivation letters. Last minute three participants had to cancel due to personal reasons which reduced the final number of participants to 27.
The training programme from the AQUAEXCEL2020 project is set up to improve the research capacity across Europe. The exchange will be targeted at training a new generation of aquaculture researchers and industry representatives working in the field in one of the EU member states or new members and associated states of the enlarged EU, facilitating access with special focus on young researchers. Based on this, participants were selected based on the criteria: EU/ outside EU and member states, relevant background and future applicability of learned theory and techniques to own and institute's research.

## 2.2 Course activities

Twenty- seven aquaculture professionals from thirteen different European countries attended the first AQUAEXCEL2020 face-to-face training course on RAS Technology. The activities during the training course are presented in detail in the course agenda in Annex 3 and course tutors and their contact details are listed in Annex 4. In the training course, theoretical lectures were interspersed with technical visits and practical assignments. In that way, scientific concepts could be verified by the course participants and put into a practical context enabling participants "learning-by-doing". Higher cognitive levels of learning were gained in discussions throughout the course as well as during the industry mini seminar.

The training as well as the seminar provided an interaction with top specialists, lecturers as well as industry stakeholders, with innovative examples, active in the field of RAS (from France, Norway, the Netherlands, USA, Denmark.

The goal was to continuously have as many lecturers present during the course, lunches and social dinners to give participants the opportunity to interact with top specialists in the field. Throughout the course a minimum of three lecturers were present constantly. During the excursion, there was sufficient time for the participants to ask farmers questions.

A special (web based) Blackboard learning environment was created, to which students and lecturers had access. All training material of the course were placed on the Blackboard, with an online module established specifically for this training course (see Figure 3 with print-screens of the site). The site contains links to the presentations and instructional material used during the course, as well as a discussion board and library of articles, informative literature and documents.

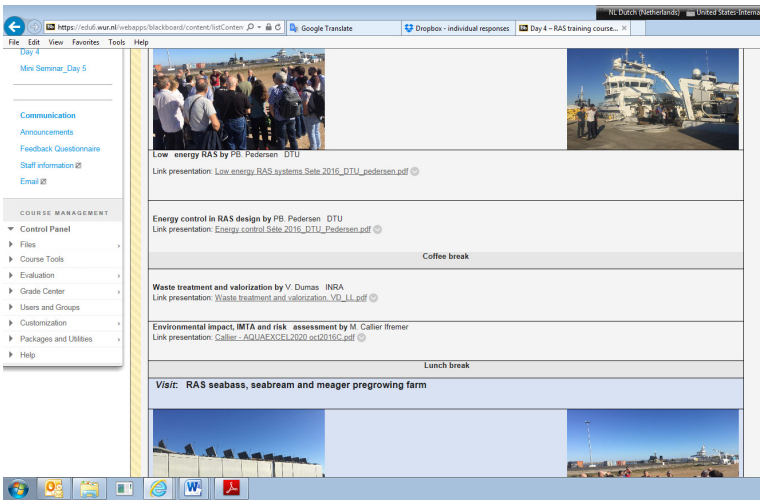

Figure 3: Print screen of an example Blackboard site

After a short introduction explaining the context of the training course (the AQUAEXCEL2020 project), each participant could introduce him/herself briefly.

The first part of the training course was devoted to presenting the water quality requirements (determining and limiting water quality parameters) for optimal welfare and performance of the fish. RAS offer the possibility of controlling most of the water quality parameters and of keeping them at an optimal level, but what is the optimal level for each of those parameters? What do we know about the substances that accumulate in time in the recirculated water and how to control their build-up? The concentration levels of the limiting parameter are due to the fish metabolism and activity.
The second part of the training was aimed at providing to the participants the information and tools necessary to quantify the fish productions (soluble and particulate substances) and consumptions (oxygen and feed), which are directly responsible for the concentration level of each of the limiting parameters in the rearing water. The objective of a RAS designer is then to define the right treatment tools, the right sizing of those tools and their right management for maintaining the optimal water quality demanded by the fish. This necessitates mastering the mass balance approach.

In recirculation systems, the proper management and control of the bacterial activity in all components of the system and particularly in the biofilter, which enables transforming the toxic nitrogen compounds (Ammonia and nitrites) in a low toxicity form (nitrate) is a key, as well as the biosecurity approach. This was the focus of the third part of the training.

The control of the rearing water quality despite a very low makeup water consumption compared to traditional systems necessitates energy. For the economy of the farms and its sustainability, it is important to minimize the energy needs. The fourth part of the training was devoted to that problem.

Even if one of the objectives of RAS is to keep them as independent of the surrounding environment as possible, they still have strong links with it particularly through the wastes they generate. The fifth part of the training examined the fresh water and marine RAS waste valorisation.

All the presentations were organized in the mornings (Figure 4).

Figure 4. Participants during a morning lecture (left) and during a facility visit (right).

On the afternoon of the first training day, a visit of the Palavas research station, which is partner in the TransNational Access programme of the project, was organized. During the two following afternoons, the trainees were divided into 3 groups to carry out design exercises. On the afternoon of the fourth day, a visit to a RAS farm specialized in seabass and seabream fingerlings pre-growing was organised. This farm is pre-growing fingerlings from two large marine hatcheries and sends them either by trucks or by boat depending on the location of the on-growing farms buying them. On the day of the visit from course participants, their boat was loaded with 2 tons of fingerlings.

On the last morning, a mini-seminar allowed to exchange with specialists of the industry on some key questions that were identified during the previous days. They were classified in 2 categories: generic questions (why so many RAS failures in the past, what new developments…) and more technical questions (precise design of gas exchange systems, bacterial management…). The discussion ended with a common lunch taken in a nearby restaurant.

## *2.3 Post- Course activities*

After completion of the course, participants were asked for feedback via an online survey (Figure 5), of which the results are given in Annex 5. These results will help the training course organisers to improve the distance learning course and future AQUAEXCEL2020 training courses and evaluate the need for future courses. The results of this evaluation exercise were confidential and anonymous so participants could be honest in their comments. The survey was online and took about 15 minutes to complete.

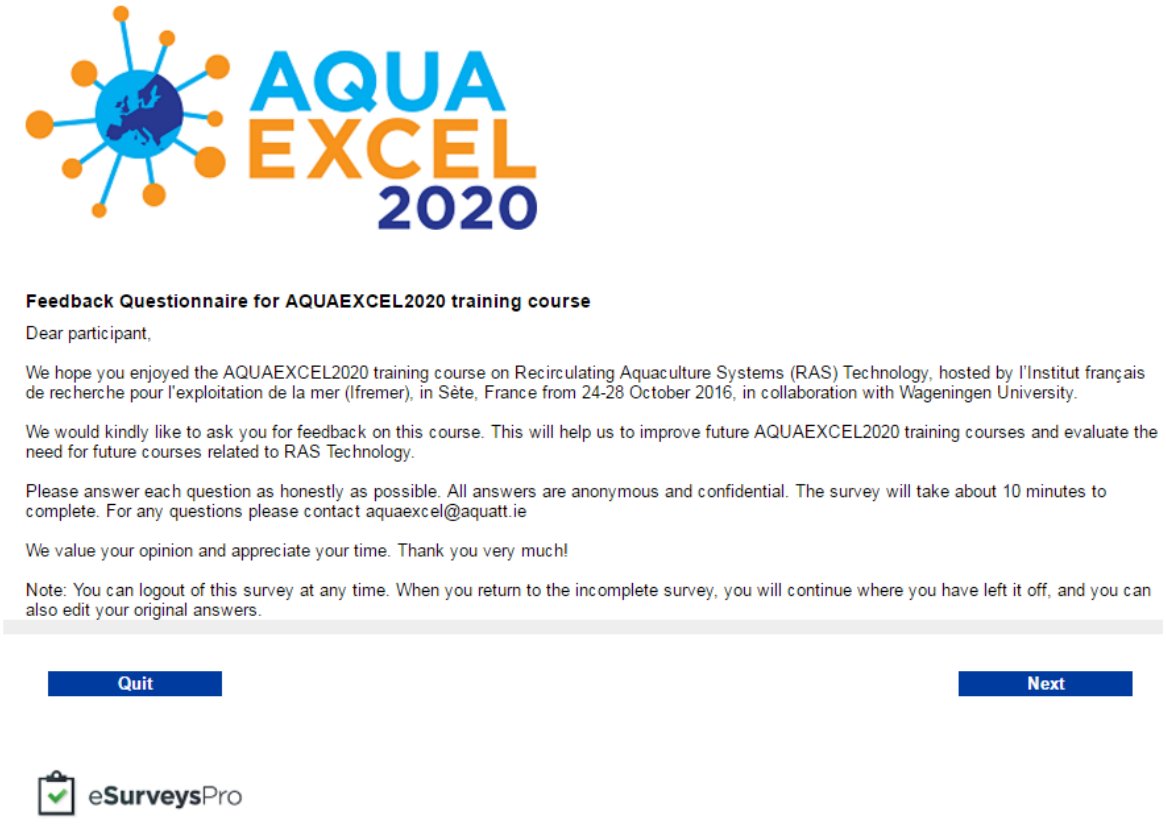

Figure 5: Print screen of welcome page of the online evaluation survey.

Participants were given a certificate of participation if requested upon completion of the course (Annex 6). All lectures were also made available to participants after the course through the BlackBoard system at Wageningen University.

AquaTT organised pre- and post-course activities, such as finalising course design, developing promotional leaflets and practical information documents, assisting in the organisation, managing the registrations, publishing and promoting the training courses, as well as carrying out and analysing the evaluations.

# 3. Conclusions

Participants who attended the RAS course in France were mainly Postgraduates (50%), followed by Postdoctoral Researchers (11%) with 'Others' contributing 28% (e.g. fish farmers, consultants, investors). Over 70% of participants heard about the course from colleagues (44.5%) or though internet searches (28%). The online feedback survey was answered by 18 participants, and all results are included in Annex 5.

Almost half of the participants received travel and subsidence funding to attend this course from their employers, while about 30% were self-funded and about 20% received funds through projects/grants. It therefore looks like two complementary dissemination approaches will be successful to promote this type of course, 1) dissemination of course information to companies and institutes, and 2) direct dissemination to individuals through stakeholder mailing lists. Furthermore, the fact that one third of the participants of this RAS course were willing to self-fund their travel expenses emphasises that it is an important and timely topic.

The training course achieved the desired objective to inform and teach participants about the design, evaluation and operation of RAS technology through a range of learning elements including traditional lectures, and practical forms of learning to apply knowledge like practical tutorial model training and field trips. This is evident as the percentage of participants with detailed knowledge of RAS technology increased from 5% before the training course, to over 70% after the completion of the course, based on feedback results. All 33% of the participants who indicated only basic knowledge on RAS before the course, improved to at least moderate knowledge.

The main conclusion which can be drawn from the participant's feedback is that the RAS training course was overall very successful. 88% of the participants who answered the survey awarded the course either good or excellent grades. Three features of the course which were commended by many participants leading to the grading were 1) the good mix of attending people from industry, academia and consultancy, 2) the balanced mix of presentations with visits and design exercises, and 3) many opportunities for discussions and networking.

Some examples of reasons for excellent grades are:

- "Excellent course on both theoretical and practical aspects thanks to the organizers who designed a very relevant program covering all aspects of recirculated

aquaculture. The mixed audience with consultants, producers, researchers in the different fields was a great added value to this week with a good room devoted to very rich exchanges between scientists."

- "It was good to mix technical and precise presentation with visit, design exercise and to finish with this discussion on Friday morning."
- "Course presenters were all experts in their fields but also excellent at delivering the information."

The most important factors to decide to enrol for the training course were the course content, course organisers and course trainers. The "best thing(s) about the training course" which were mentioned by participants in the survey were:

- "Networking" - participants described their experiences in the survey:
  - "a very good mix of academia and industry"
  - "the variety and the relevance of the audience"
  - "it is really useful for young generation to integrate to business people and learn about more practical knowledge from scientific people and experienced people
- "The variety and the relevance of the topics"
- "The structure and learning methods used in the training course":
  - Morning lectures; afternoon either group work or site visits
  - The Industry Seminar on Friday; discussions were very informative as well as the 'free' room for questions and answers. The scope for discussions during the seminar and among social moments of the course were particularly appreciated with around 95% from good to excellent.

94% of the participants stated that the opportunity to exchange with industry professionals during the Industry Seminar was excellent (41%) or good (53%) for them personally.

Over 80% of the participants were happy with the organisation leading up to the course, like simple registration procedure (88% agree), communication of the course (83% agree), and clear information before the start (84% agree). A list of participants has been requested after the end of the course and it has been suggested to make it available already before the course. We will consider ways to allow participants to exchange their personal information directly with each other to ensure privacy rights of all participants.

Areas which could be improved upon for the remaining AQUAEXCEL2020 training courses included some little organisational aspects: name tags and printed copies of the Powerpoint presentations and to order the presentations by themes.

One of the participants suggested to have a two-weeks course. Some participants added some suggestions for extra subjects:

- More subjects from biological point of view: fish nutrition, feed composition with differences among RAS diets and offshore diets
- Economics of RAS
- A module of biofloc culture

These points will be taken into consideration in the organisation of future courses, particularly the upcoming RAS course in 2018 at Wageningen University.

Participants had mostly positive experiences during the course with the content, format and delivery of material. The trainers were also commended for their enthusiasm, preparedness and willingness to engage with the participants. With 94% of participants being interested in participating in a follow-up course in the future, and 90% of participants being willing to recommend the course to a fellow student or colleague, it is clear, that the RAS training course was a success and a valuable experience for all participants involved.

# Glossary

AQUAEXCEL2020: AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020

RAS: Recirculating Aquaculture Systems

# Document information

| | | | |
|---|---|---|---|
| **EU Project N°** | 652831 | **Acronym** | AQUAEXCEL2020 |
| **Full Title** | AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020 | | |
| **Project website** | www.aquaexcel.eu | | |

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|---|---|---|---|---|
| **Deliverable** | **N°** | D4.4a | **Title** | Face-to-face training course 1 |
| **Work Package** | **N°** | 4 | **Title** | Integration, training, dissemination and cooperation |

| | | | | |
|---|---|---|---|---|
| **Date of delivery** | **Contractual** | 30/11/2016 (Month M14) | **Actual** | 15/12/2016 (M15) |
| **Dissemination level** | X | **PU Public, fully open, e.g. web** | | |
| | | **CO Confidential, restricted under conditions set out in Model Grant Agreement** | | |
| | | **CI Classified, information as referred to in Commission Decision 2001/844/EC.** | | |

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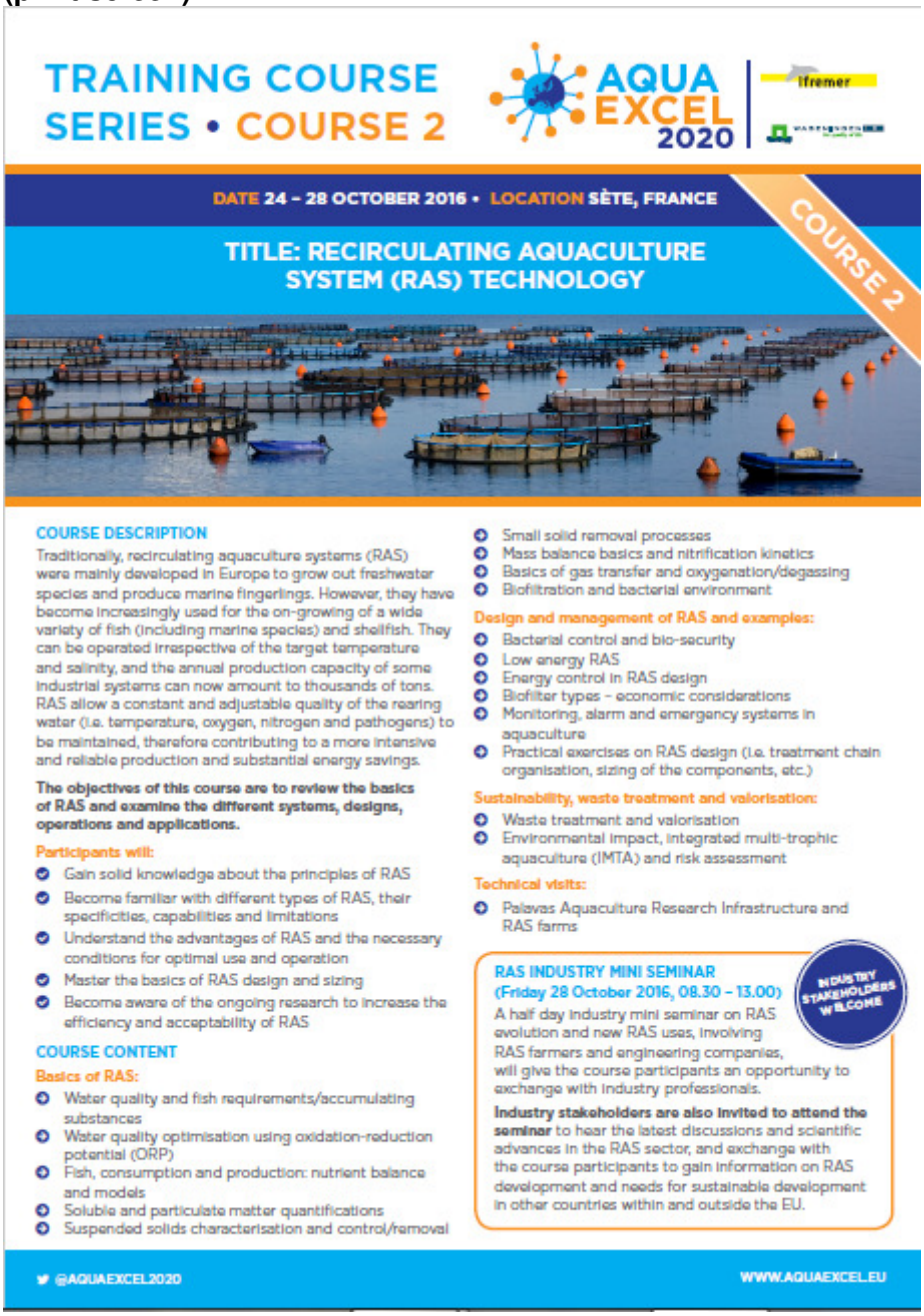
| **Version log** | | | |
|---|---|---|---|
| **Issue Date** | **Revision N°** | **Author** | **Change** |
| 21/11/2016 | V0 | Claudia Junge | |
| 21/11/2016 | V1 | Jean Paul Blancheton | |
| 28/11/2016 | V2 | Claudia Junge | |
| 30/11/2016 | V3 | Jean Paul Blancheton | |
| 30/11/2016 | V4 | Claudia Junge | |
| 07/12/2016 | V5 | Geertje Schlaman | |
| 19/12/2016 | V6 | Claudia Junge | |
| 19/12/2016 | V7 | Marieke Reuver | |
| 04/01/2017 | V8 | Claudia Junge | |

# Annex 1: Promotional Leaflet – course 2

**(print screen)**



TRAINING COURSE SERIES • COURSE 2

AQUA EXCEL 2020

DATE 24 – 28 OCTOBER 2016 • LOCATION SÈTE, FRANCE

COURSE 2

TITLE: RECIRCULATING AQUACULTURE SYSTEM (RAS) TECHNOLOGY

COURSE DESCRIPTION

Traditionally, recirculating aquaculture systems (RAS) were mainly developed in Europe to grow out freshwater species and produce marine fingerlings. However, they have become increasingly used for the on-growing of a wide variety of fish (including marine species) and shellfish. They can be operated irrespective of the target temperature and salinity, and the annual production capacity of some industrial systems can now amount to thousands of tons. RAS allow a constant and adjustable quality of the rearing water (i.e. temperature, oxygen, nitrogen and pathogens) to be maintained, therefore contributing to a more intensive and reliable production and substantial energy savings.

**The objectives of this course are to review the basics of RAS and examine the different systems, designs, operations and applications.**

Participants will:

- Gain solid knowledge about the principles of RAS
- Become familiar with different types of RAS, their specificities, capabilities and limitations
- Understand the advantages of RAS and the necessary conditions for optimal use and operation
- Master the basics of RAS design and sizing
- Become aware of the ongoing research to increase the efficiency and acceptability of RAS

COURSE CONTENT

Basics of RAS:

- Water quality and fish requirements/accumulating substances
- Water quality optimisation using oxidation-reduction potential (ORP)
- Fish, consumption and production: nutrient balance and models
- Soluble and particulate matter quantifications
- Suspended solids characterisation and control/removal
- Small solid removal processes
- Mass balance basics and nitrification kinetics
- Basics of gas transfer and oxygenation/degassing
- Biofiltration and bacterial environment

Design and management of RAS and examples:

- Bacterial control and bio-security
- Low energy RAS
- Energy control in RAS design
- Biofilter types – economic considerations
- Monitoring, alarm and emergency systems in aquaculture
- Practical exercises on RAS design (i.e. treatment chain organisation, sizing of the components, etc.)

Sustainability, waste treatment and valorisation:

- Waste treatment and valorisation
- Environmental impact, integrated multi-trophic aquaculture (IMTA) and risk assessment

Technical visits:

- Palavas Aquaculture Research Infrastructure and RAS farms

RAS INDUSTRY MINI SEMINAR
(Friday 28 October 2016, 08.30 – 13.00)

INDUSTRY STAKEHOLDERS WELCOME

A half day industry mini seminar on RAS evolution and new RAS uses, involving RAS farmers and engineering companies, will give the course participants an opportunity to exchange with industry professionals.

**Industry stakeholders are also invited to attend the seminar** to hear the latest discussions and scientific advances in the RAS sector, and exchange with the course participants to gain information on RAS development and needs for sustainable development in other countries within and outside the EU.

@AQUAEXCEL2020 WWW.AQUAEXCEL.EU

# TRAINING COURSE SERIES • COURSE 2

AQUA EXCEL 2020

**TARGET AUDIENCE:**

The full course is designed for aquaculture professionals with a university degree (e.g. engineers, researchers, etc.) interested in the potential applications of RAS (i.e. controlled intensive fish farming, water reuse, use of environmentally friendly technologies, etc.).

Interested industry stakeholders who are not involved in the full course are welcome to take part in the industry mini seminar.

**LOCATION:** Ifremer Sète research station, Avenue Jean Monnet, 34203 Sète, France

**TIME:** Monday 24 (08:30) to Friday 28 (12:45) October 2016

**COURSE ORGANISERS:** Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer) (France) and Wageningen University (the Netherlands)

**REGISTRATION:**

**Register online at:** www.aquaexcel.eu/index.php/aquaexcel-courses/h2020-training-courses

**Participants taking part in the full training course** are requested to submit their CV and a brief letter of motivation by **9 September 2016.** Places will be confirmed, at the latest, one month before the start of the training course.

**Industry participants attending the industry mini seminar only** (Friday 28 October, 08.30 - 13.00) are requested to register by submitting their affiliation and contact details.

**FEES: Course attendance is FREE, thanks to EC Horizon 2020 funding. Participants are expected to cover their own travel, subsistence and accommodation costs.**

**MAXIMUM PARTICIPANTS:** 30 people

**LANGUAGE OF INSTRUCTION AND MATERIAL:** English

**COURSE TUTORS:**

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Designed and developed by A.Gain TT

this project has received funding from the european unions horizon 2020 research and innovation programme under grant agreement no 652831. this publication reflects only the view of the author, and the european commission cannot be held responsible for any use which may be made of the information contained therein

# Annex 2: Application Form for Training Course

**(print screen, 2pages)**

Please complete all sections of this form and email it to aquaexcel@aquatt.ie by 09 September 2016, indicating in subject: AQUAEXCEL2020 / training course #2 (Ifremer)

## Registration Form for Training Courses

### Course 2: Recirculating Aquaculture System (RAS) Technology

Organiser(s): Ifremer (Institut Français de Recherche pour L'Exploitation de la Mer)
Date: 24- 28 October 2016 (5-day course)
Location: Sete, France

Any questions about the course or application process should be sent to aquaexcel.afi@wur.nl and jean.paul.blancheton@ifremer.fr

We look forward to welcoming you to the course.

**Contact details**

| | |
|---|---|
| Title: | |
| Surname: | |
| First Name(s): | |
| Email: | |
| Telephone: | |
| Date of Birth: | |
| Gender: | |

**Relevant information**

| | |
|---|---|
| Organisation Name: | |
| Organisation Type:<br>• University<br>• Research Institute<br>• SME<br>• Private Company<br>• Other (please specify) | |
| Country: | |
| Position: | |

| | |
|---|---|
| Highest Qualification:<br>• PhD<br>• DVM or equivalent<br>• MSc or equivalent<br>• BSc or equivalent<br>• Other (please specify) | |
| Research Category:<br>• Postgraduate<br>• Postdoctoral<br>• Expert<br>• Technician<br>• Other (please specify) | |
| Previous Relevant Experience: | Do you have any previous experience in the use of online experimental data management systems? If so, please describe briefly. |
| Additional Support: | Do you have any particular needs, disabilities or access issues that may require additional support? |

Please complete all sections of this form and email it to: aquaexcel@aquatt.ie by 09 September 2016, indicating in subject: AQUAEXCEL2020 / training course #2 (Ifremer)

# Annex 3: Course Agenda

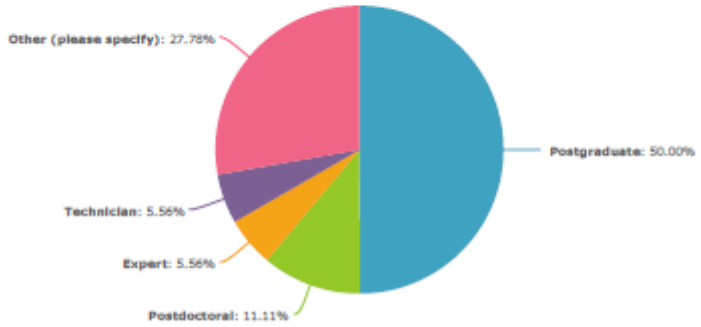
| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 8:30-9:30 | **Introduction**<br>JP. Blancheton Ifremer | **Soluble and particulate matter quantifications**<br>E. Eding WU | **Basics of gas transfer oxygenation/degassing**<br>R. Piedrahita | **Low energy RAS**<br>PB. Pedersen DTU | **Mini seminar with industry partners:**<br>JM Moulin LPDS (hatchery and pregrowing Aqualand group production)<br>P. Cacot LPDS (new species and systems Aqualand group R&D) |
| 9:30 – 10:30 | **Water quality and fish requirements, accumulating substances**<br>V. Mota (Nofima) | **Suspended solids characterization and control / removal**<br>R. Piedrahita | **Biofiltration and bacterial environment**<br>O. Vadstein NTNU | **Energy control in RAS design**<br>PB. Pedersen DTU | |
| **Coffee break** | | | | | |
| 10:45 – 11:45 | **Water quality optimisation using ORP**<br>J. Bosmans IDEE | **Small solid removal processes**<br>B. Barrut Coldep | **Bacterial control and bio-security**<br>K. Attramadal NTNU | **Waste treatment and valorization**<br>V. Dumas INRA | **Mini seminar continued**<br>J Bosmans IDEE (Engineering company)<br>B. Barrut, COLDEP (Engineering company)<br>A. Lebreton VETAEU (veterinary company) |
| 11:45 – 12:45 | **Fish, consumptions and productions: nutrient balance and model**<br>E. Eding WU | **Mass balance basics nitrification kinetics Biofilter sizing**<br>JP. Blancheton Ifremer | **Low energy RAS Seaweeds in integrated aquaculture**<br>P. Cacot LPDS | **Environmental impact, IMTA and risk assessment**<br>M. Callier Ifremer | |
| **Lunch break** | | | | | |
| 14:15 – 17:45 | ***Visit*: Palavas Ifremer research station** | ***Design exercises*** | ***Design exercises*** | ***Visit*: RAS seabass, seabream and meager pregrowing farm** | **FREE** |

# Annex 4: Course Tutors

| Last name | First name | Email | Position | Affiliation |
|---|---|---|---|---|
| Attramadal | Kari | Kari.Attramadal@bio.ntnu.no | Researcher | NTNU, Norway |
| Barrut | Bertrand | bertrand.barrut@coldep.com | Research Director | Coldep Company, France |
| Blancheton | Jean Paul | jean.paul.blancheton@ifremer.fr | Researcher | Ifremer, France |
| Bosmans | Jérôme | bosmansj@internode.on.net | Research Developer | IDEE Company, France |
| Cacot | Philippe | philippe.cacot@cirad.fr | Researcher | Cirad / Lpds Company, France |
| Dumas | Victor | vdumas@etu.isara.fr | Researcher | ISARA Lyon, France |
| Eding | Ep | Ep.Eding@wur.nl | Education and Research | Wageningen University, The Netherlands |
| Mota | Vasco | Vasco.Mota@Nofima.no | Researcher | Nofima, Norway |
| Pedersen | Per | pbp@aqua.dtu.dk | Head of Section for Aquaculture | DTU Aqua, Denmark |
| Piedrahita | Raul | rhpiedrahita@ucdavis.edu | Emeritus Professor | University of California, USA |
| Vadstein | Olav | olav.vadstein@biotech.ntnu.no | Professor | NTNU, Norway |

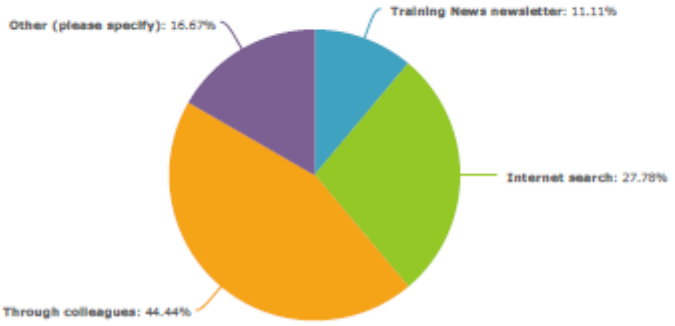
# Annex 5: Survey Results

**1. 1. What is your current research category?**



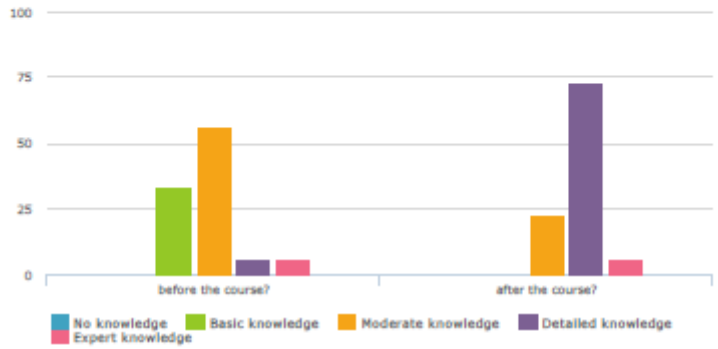

| | | | |
|---|---|---|---|
| Postgraduate | 50.00% | | 9 |
| Postdoctoral | 11.11% | | 2 |
| Expert | 5.56% | | 1 |
| Technician | 5.56% | | 1 |
| Other (please specify) | 27.78% | | 5 |
| | | Total Responses | 18 |
| | | Skipped | 0 |

2. 2. How did you hear about this course?




| | | |
|---|---|---|
| Training News newsletter | 11.11% | 2 |
| Internet search | 27.78% | 5 |
| Through colleagues | 44.44% | 8 |
| Other (please specify) | 16.67% | 3 |
| | Total Responses | 18 |
| | Skipped | 0 |

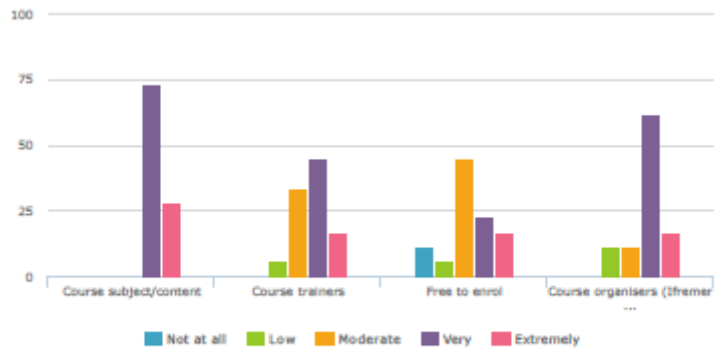
### 3. 3. How would you rate your knowledge of RAS:




| | No knowledge | Basic knowledge | Moderate knowledge | Detailed knowledge | Expert knowledge | Responses |
|---|---|---|---|---|---|---|
| before the course? | **0** 0.00% | **6** 33.33% | **10** 55.56% | **1** 5.56% | **1** 5.56% | 18 |
| after the course? | **0** 0.00% | **0** 0.00% | **4** 22.22% | **13** 72.22% | **1** 5.56% | 18 |

| | |
|---|---|
| Total Responses | 18 |
| Skipped | 0 |

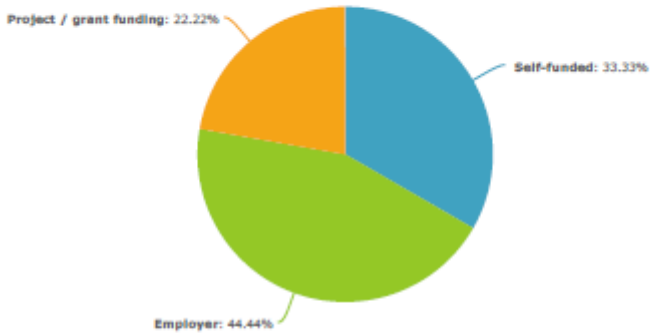
**4. 4. How important were the following factors for you when deciding to enrol into this training course?**




| | Not at all | Low | Moderate | Very | Extremely | Responses |
|---|---|---|---|---|---|---|
| Course subject/content | **0** 0.00% | **0** 0.00% | **0** 0.00% | **13** 72.22% | **5** 27.78% | 18 |
| Course trainers | **0** 0.00% | **1** 5.56% | **6** 33.33% | **8** 44.44% | **3** 16.67% | 18 |
| Free to enrol | **2** 11.11% | **1** 5.56% | **8** 44.44% | **4** 22.22% | **3** 16.67% | 18 |
| Course organisers (Ifremer and Wageningen University) | **0** 0.00% | **2** 11.11% | **2** 11.11% | **11** 61.11% | **3** 16.67% | 18 |

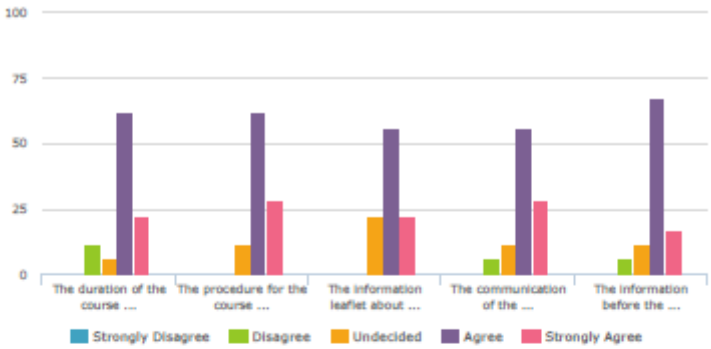
| | |
|---|---|
| Total Responses | 18 |
| Skipped | 0 |

**5. 5. How were you funded/how did you fund the travel and subsistence expenses?**




| | | | |
|---|---|---|---|
| Self-funded | 33.33% | | 6 |
| Employer | 44.44% | | 8 |
| Project / grant funding | 22.22% | | 4 |
| Other (please specify) | 0.00% | | 0 |
| | | Total Responses | 18 |
| | | Skipped | 0 |

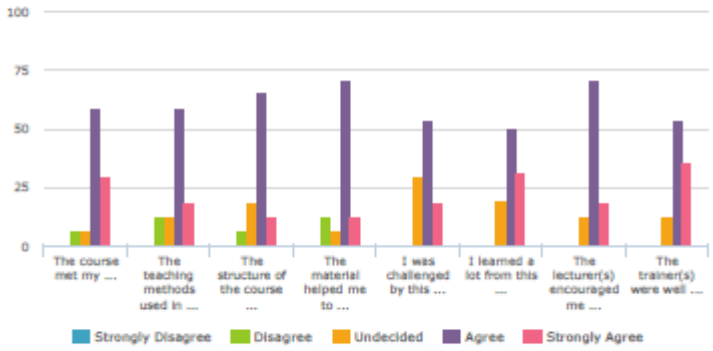
**6. 6. Please read the following statements and indicate how they correspond to your experience of the course organisation.**




| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree | Responses |
|---|---|---|---|---|---|---|
| The duration of the course was good. | 0 0.00% | 2 11.11% | 1 5.56% | 11 61.11% | 4 22.22% | 18 |
| The procedure for the course registration was clear and simple. | 0 0.00% | 0 0.00% | 2 11.11% | 11 61.11% | 5 27.78% | 18 |
| The information leaflet about the course was informative and visually attractive. | 0 0.00% | 0 0.00% | 4 22.22% | 10 55.56% | 4 22.22% | 18 |
| The communication of the course (announcements, programme, etc.) was good. | 0 0.00% | 1 5.56% | 2 11.11% | 10 55.56% | 5 27.78% | 18 |
| The information before the start of the course was clear. | 0 0.00% | 1 5.56% | 2 11.11% | 12 66.67% | 3 16.67% | 18 |

| | |
|---|---|
| Total Responses | 18 |
| Skipped | 0 |

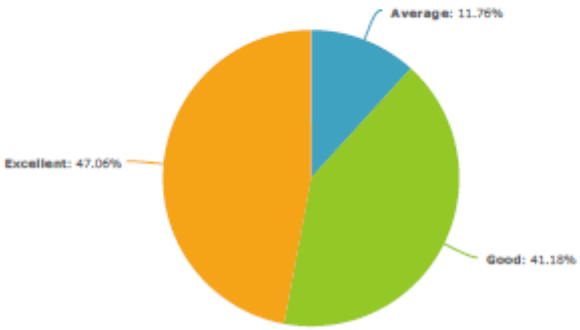
**8. 8. Please read the following statements and indicate how they correspond to your experience of the course.**




| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree | Responses |
|---|---|---|---|---|---|---|
| The course met my expectations. | 0 0.00% | 1 5.88% | 1 5.88% | 10 58.82% | 5 29.41% | 17 |
| The teaching methods used in this course helped me achieve the course's learning outcomes. | 0 0.00% | 2 11.76% | 2 11.76% | 10 58.82% | 3 17.65% | 17 |
| The structure of the course was logical. | 0 0.00% | 1 5.88% | 3 17.65% | 11 64.71% | 2 11.76% | 17 |
| The material helped me to master the content. | 0 0.00% | 2 11.76% | 1 5.88% | 12 70.59% | 2 11.76% | 17 |
| I was challenged by this course. | 0 0.00% | 0 0.00% | 5 29.41% | 9 52.94% | 3 17.65% | 17 |
| I learned a lot from this course. | 0 0.00% | 0 0.00% | 3 18.75% | 8 50.00% | 5 31.25% | 16 |
| The lecturer(s) encouraged me to think about the subject matter. | 0 0.00% | 0 0.00% | 2 11.76% | 12 70.59% | 3 17.65% | 17 |
| The trainer(s) were well prepared and knowledgeable. | 0 0.00% | 0 0.00% | 2 11.76% | 9 52.94% | 6 35.29% | 17 |

| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

9. 9. If you look at all aspects of the course, which grade would you award this course?




| | | | |
|---|---|---|---|
| Poor | 0.00% | | 0 |
| Below Average | 0.00% | | 0 |
| Average | 11.76% | | 2 |
| Good | 41.18% | | 7 |
| Excellent | 47.06% | | 8 |
| | | Total Responses | 17 |
| | | Skipped | 1 |

10. 10. Please comment on the grade you gave the course (question number 9):

| | |
|---|---|
| Total Responses | 9 |
| Skipped | 9 |

11. 11. The best thing(s) about this course was/were:

| | |
|---|---|
| Total Responses | 13 |
| Skipped | 5 |

12. 12. The thing(s) to be improved was/were:

| | |
|---|---|
| Total Responses | 13 |
| Skipped | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Introduction - **relevance** | **0** 0.00% | **1** 6.25% | **2** 12.50% | **11** 68.75% | **2** 12.50% | 16 |
| Water quality and fish requirements / accumulating substances - **presentation and materials** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **9** 52.94% | **7** 41.18% | 17 |
| Water quality and fish requirements / accumulating substances - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **9** 52.94% | **7** 41.18% | 17 |
| Water quality optimisation using ORP - **presentation and materials** | **0** 0.00% | **1** 5.88% | **7** 41.18% | **8** 47.06% | **1** 5.88% | 17 |
| Water quality optimisation using ORP - **relevance** | **0** 0.00% | **2** 11.76% | **4** 23.53% | **10** 58.82% | **1** 5.88% | 17 |
| Fish, consumptions and productions: nutrient balance and model - **presentation and materials** | **0** 0.00% | **0** 0.00% | **2** 11.76% | **10** 58.82% | **5** 29.41% | 17 |
| Fish, consumptions and productions: nutrient balance and model - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **7** 41.18% | **9** 52.94% | 17 |
| Visit: Palavas - **organisation of visit** | **0** 0.00% | **1** 6.67% | **1** 6.67% | **9** 60.00% | **4** 26.67% | 15 |
| Visit: Palavas - **relevance** | **0** 0.00% | **1** 6.25% | **1** 6.25% | **8** 50.00% | **6** 37.50% | 16 |

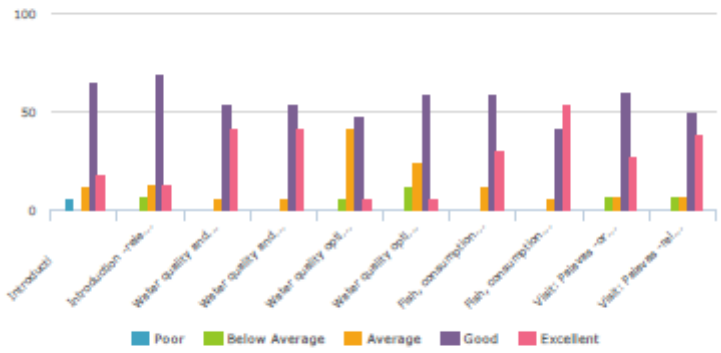
| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

**13. 13. Did you miss any subjects/topics?**

**Please indicate any topics that, in your opinion, should have been included in the course:**

| | |
|---|---|
| Total Responses | 7 |
| Skipped | 11 |

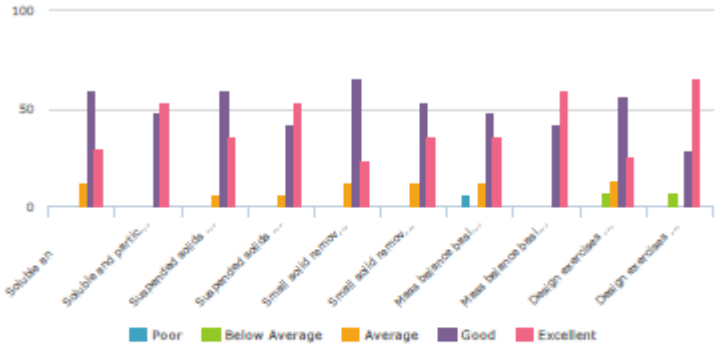
**14. 14. How would you rate the quality of the following parts from Day1?**




| | Poor | Below Average | Average | Good | Excellent | Responses |
|---|---|---|---|---|---|---|
| Introduction - **presentation and materials** | **1** 5.88% | **0** 0.00% | **2** 11.76% | **11** 64.71% | **3** 17.65% | 17 |
| Introduction - **relevance** | **0** 0.00% | **1** 6.25% | **2** 12.50% | **11** 68.75% | **2** 12.50% | 16 |
| Water quality and fish requirements / accumulating substances - **presentation and materials** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **9** 52.94% | **7** 41.18% | 17 |
| Water quality and fish requirements / accumulating substances - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **9** 52.94% | **7** 41.18% | 17 |
| Water quality optimisation using ORP - **presentation and materials** | **0** 0.00% | **1** 5.88% | **7** 41.18% | **8** 47.06% | **1** 5.88% | 17 |
| Water quality optimisation using ORP - **relevance** | **0** 0.00% | **2** 11.76% | **4** 23.53% | **10** 58.82% | **1** 5.88% | 17 |
| Fish, consumptions and productions: nutrient balance and model - **presentation and materials** | **0** 0.00% | **0** 0.00% | **2** 11.76% | **10** 58.82% | **5** 29.41% | 17 |
| Fish, consumptions and productions: nutrient balance and model - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **7** 41.18% | **9** 52.94% | 17 |
| Visit: Palavas - **organisation of visit** | **0** 0.00% | **1** 6.67% | **1** 6.67% | **9** 60.00% | **4** 26.67% | 15 |
| Visit: Palavas - **relevance** | **0** 0.00% | **1** 6.25% | **1** 6.25% | **8** 50.00% | **6** 37.50% | 16 |

| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

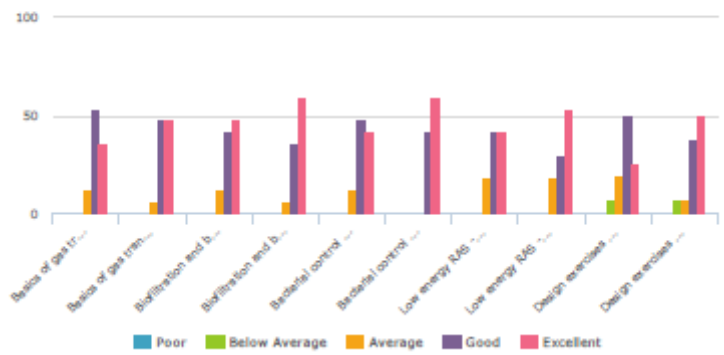
**15. 15. How would you rate the quality of the following parts from Day2?**




| | Poor | Below Average | Average | Good | Excellent | Responses |
|---|---|---|---|---|---|---|
| Soluble and particulate matter quantifications - **presentation and materials** | 0 0.00% | 0 0.00% | 2 11.76% | 10 58.82% | 5 29.41% | 17 |
| Soluble and particulate matter quantifications - **relevance** | 0 0.00% | 0 0.00% | 0 0.00% | 8 47.06% | 9 52.94% | 17 |
| Suspended solids characterization and control / removal - **presentation and materials** | 0 0.00% | 0 0.00% | 1 5.88% | 10 58.82% | 6 35.29% | 17 |
| Suspended solids characterization and control / removal - **relevance** | 0 0.00% | 0 0.00% | 1 5.88% | 7 41.18% | 9 52.94% | 17 |
| Small solid removal processes - **presentation and materials** | 0 0.00% | 0 0.00% | 2 11.76% | 11 64.71% | 4 23.53% | 17 |
| Small solid removal processes - **relevance** | 0 0.00% | 0 0.00% | 2 11.76% | 9 52.94% | 6 35.29% | 17 |
| Mass balance basics / nitrification kinetics - **presentation and materials** | 1 5.88% | 0 0.00% | 2 11.76% | 8 47.06% | 6 35.29% | 17 |
| Mass balance basics / nitrification kinetics - **relevance** | 0 0.00% | 0 0.00% | 0 0.00% | 7 41.18% | 10 58.82% | 17 |
| Design exercises - **instructions and materials** | 0 0.00% | 1 6.25% | 2 12.50% | 9 56.25% | 4 25.00% | 16 |
| Design exercises - **relevance** | 0 0.00% | 1 7.14% | 0 0.00% | 4 28.57% | 9 64.29% | 14 |

| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

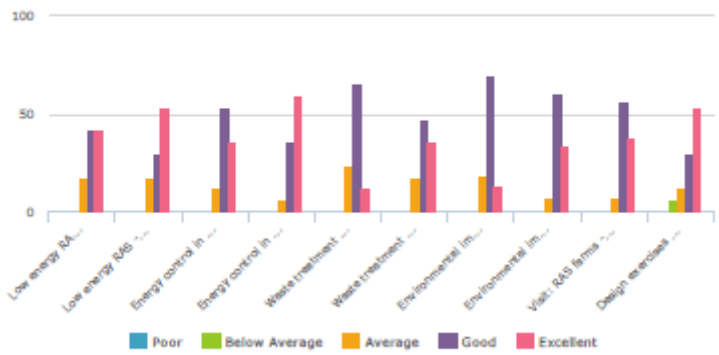
**16. 16. How would you rate the quality of the following parts from Day3?**




| | Poor | Below Average | Average | Good | Excellent | Responses |
|---|---|---|---|---|---|---|
| Basics of gas transfer and oxygenation/degassing - **presentation and materials** | **0** 0.00% | **0** 0.00% | **2** 11.76% | **9** 52.94% | **6** 35.29% | 17 |
| Basics of gas transfer and oxygenation/degassing - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **8** 47.06% | **8** 47.06% | 17 |
| Biofiltration and bacterial environment - **presentation and materials** | **0** 0.00% | **0** 0.00% | **2** 11.76% | **7** 41.18% | **8** 47.06% | 17 |
| Biofiltration and bacterial environment - **relevance** | **0** 0.00% | **0** 0.00% | **1** 5.88% | **6** 35.29% | **10** 58.82% | 17 |
| Bacterial control and bio-security - **presentation and materials** | **0** 0.00% | **0** 0.00% | **2** 11.76% | **8** 47.06% | **7** 41.18% | 17 |
| Bacterial control and bio-security - **relevance** | **0** 0.00% | **0** 0.00% | **0** 0.00% | **7** 41.18% | **10** 58.82% | 17 |
| Low energy RAS - **presentation and materials** | **0** 0.00% | **0** 0.00% | **3** 17.65% | **7** 41.18% | **7** 41.18% | 17 |
| Low energy RAS - **relevance** | **0** 0.00% | **0** 0.00% | **3** 17.65% | **5** 29.41% | **9** 52.94% | 17 |
| Design exercises - **instructions and material** | **0** 0.00% | **1** 6.25% | **3** 18.75% | **8** 50.00% | **4** 25.00% | 16 |
| Design exercises - **relevance** | **0** 0.00% | **1** 6.25% | **1** 6.25% | **6** 37.50% | **8** 50.00% | 16 |

| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

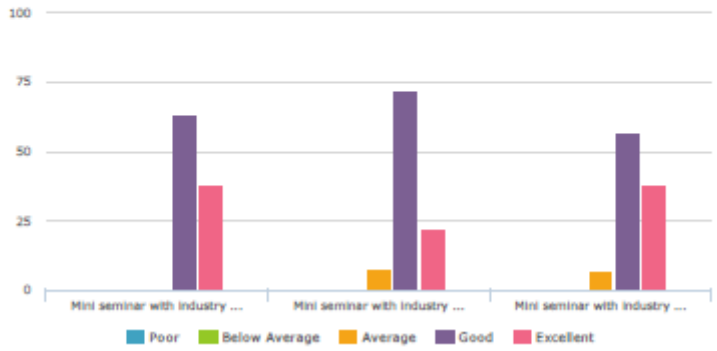
**17. 17. How would you rate the quality of the following parts from Day4?**




| | Poor | Below Average | Average | Good | Excellent | Responses |
|---|---|---|---|---|---|---|
| Low energy RAS - **presentation and materials** | 0 0.00% | 0 0.00% | 3 17.65% | 7 41.18% | 7 41.18% | 17 |
| Low energy RAS - **relevance** | 0 0.00% | 0 0.00% | 3 17.65% | 5 29.41% | 9 52.94% | 17 |
| Energy control in RAS design - **presentation and materials** | 0 0.00% | 0 0.00% | 2 11.76% | 9 52.94% | 6 35.29% | 17 |
| Energy control in RAS design - **relevance** | 0 0.00% | 0 0.00% | 1 5.88% | 6 35.29% | 10 58.82% | 17 |
| Waste treatment and valorization - **presentation and materials** | 0 0.00% | 0 0.00% | 4 23.53% | 11 64.71% | 2 11.76% | 17 |
| Waste treatment and valorization - **relevance** | 0 0.00% | 0 0.00% | 3 17.65% | 8 47.06% | 6 35.29% | 17 |
| Environmental impact, IMTA and risk ass. - **presentation and materials** | 0 0.00% | 0 0.00% | 3 18.75% | 11 68.75% | 2 12.50% | 16 |
| Environmental impact, IMTA and risk ass. - **relevance** | 0 0.00% | 0 0.00% | 1 6.67% | 9 60.00% | 5 33.33% | 15 |
| Visit: RAS farms - **organisation of visit** | 0 0.00% | 0 0.00% | 1 6.25% | 9 56.25% | 6 37.50% | 16 |
| Design exercises - **relevance** | 0 0.00% | 1 5.88% | 2 11.76% | 5 29.41% | 9 52.94% | 17 |

| | |
|---|---|
| Total Responses | 17 |
| Skipped | 1 |

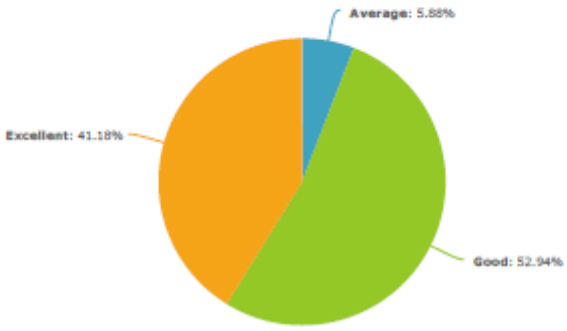
**18. 18. How would you rate the quality of the RAS Industry Mini Seminar on Day5?**




| | Poor | Below Average | Average | Good | Excellent | Responses |
|---|---|---|---|---|---|---|
| Mini seminar with industry partners - **opportunities for exchange** | **0** 0.00% | **0** 0.00% | **0** 0.00% | **10** 62.50% | **6** 37.50% | 16 |
| Mini seminar with industry partners - **representation of industry experts** | **0** 0.00% | **0** 0.00% | **1** 7.14% | **10** 71.43% | **3** 21.43% | 14 |
| Mini seminar with industry partners - **concept** | **0** 0.00% | **0** 0.00% | **1** 6.25% | **9** 56.25% | **6** 37.50% | 16 |

| | |
|---|---|
| Total Responses | 16 |
| Skipped | 2 |

**19. 19. How beneficial was the opportunity to exchange with industry professionals for you personally during the Industry Seminar on Day 5?**




| | | | |
|---|---|---|---|
| Poor | 0.00% | | 0 |
| Below Average | 0.00% | | 0 |
| Average | 5.88% | | 1 |
| Good | 52.94% | | 9 |
| Excellent | 41.18% | | 7 |
| | | Total Responses | 17 |
| | | Skipped | 1 |

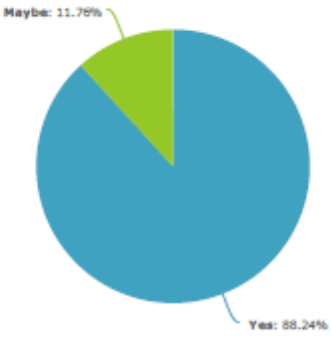
**20. 20. Please suggest changes and/or improvements you would like to see made to the trainers' approach to teaching and facilitating:**

| | |
|---|---|
| Total Responses | 5 |
| Skipped | 13 |

21. **21. Would you like to attend a follow-up course in the future.**


| | | |
|---|---|---|
| Yes | 94.12% | 16 |
| No | 0.00% | 0 |
| Maybe | 5.88% | 1 |
| | Total Responses | 17 |
| | Skipped | 1 |

22. **22. Would you recommend this course to a fellow student/colleague?**

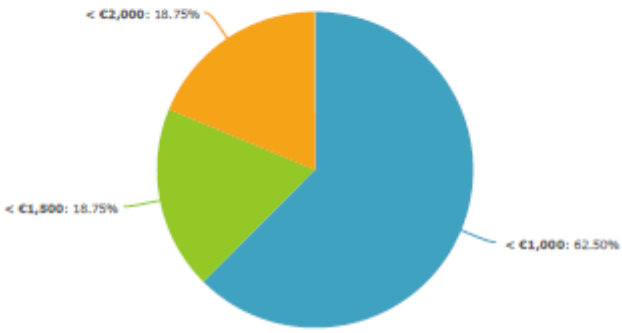



| | | |
|---|---|---|
| Yes | 88.24% | 15 |
| No | 0.00% | 0 |
| Maybe | 11.76% | 2 |
| | Total Responses | 17 |
| | Skipped | 1 |

23. **23. Please describe your learning experience in "Twitter" style (140 characters or less):**

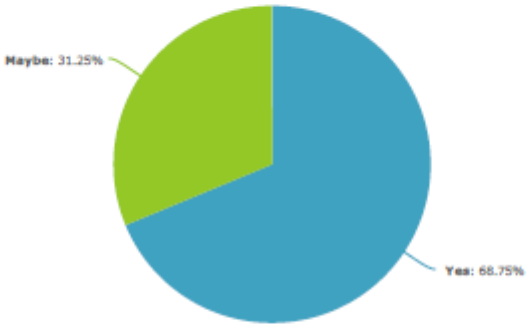
| | |
|---|---|
| Total Responses | 6 |
| Skipped | 12 |

24. **24. The RAS course was subsidised. What would be the maximum amount you/your company could afford to pay for a similar course?**




| | | | |
|---|---|---|---|
| < €1,000 | 62.50% | | 10 |
| < €1,500 | 18.75% | | 3 |
| < €2,000 | 18.75% | | 3 |
| < €3,000 | 0.00% | | 0 |
| > €3,000 | 0.00% | | 0 |
| | | Total Responses | 16 |
| | | Skipped | 2 |

25. **25. Would you or your institute be interested in future RAS courses organised by Ifremer and WU at the cost indicated by you above?**




| | | | |
|---|---|---|---|
| **Yes** | 68.75% | | 11 |
| **No** | 0.00% | | 0 |
| **Maybe** | 31.25% | | 5 |
| | | Total Responses | 16 |
| | | Skipped | 2 |

26. **26. Do you have any other suggestions or feedback?**

| | |
|---|---|
| Total Responses | 2 |
| Skipped | 16 |

27. **This evaluation is processed anonymously. However, if you are open for questions please leave your name and contact details:**

| | |
|---|---|
| Total Responses | 6 |
| Skipped | 12 |

# Annex 6: Certificate of Participation

**(print screen)**

AQUAEXCEL2020 - Training Course

**CERTIFICATE OF PARTICIPATION**

This certificate confirms that the following candidate participated in the AQUAEXCEL2020 Training Course

**"RECIRCULATING AQUACULTURE SYSTEM (RAS) TECHNOLOGY"**

provided by Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer) and Wageningen University, Netherlands

**24-28 October 2016**

*This Distance Learning Training Course was held as part of the AQUAEXCEL2020 project funded by the EU Horizon 2020 research and innovation programme under grant agreement no 652831.*
*http://www.aquaexcel.eu/index.php/aquaexcel2020*

**Training Course Details**

- The objectives of this course were to review the basics of RAS and examine the different systems, designs, operations and applications.
- A half day industry mini seminar on RAS evolution and new RAS uses, involving RAS farmers and engineering companies, gave the course participants an opportunity to exchange with industry professionals.
- The 5 day-course was taught by 14 tutors who are all experts in their field.

Dr Jean Paul Blancheton,
**Ifremer**

Ir Geertje Schlaman
**Wageningen University**

# Annex 7: Check List

Deliverable Check list (to be checked by the "Deliverable leader")

| | Check list | | Comments |
|---|---|---|---|
| BEFORE | I have checked the due date and have planned completion in due time | | *Please inform Management Team of any foreseen delays* |
| | The title corresponds to the title in the DOW | | *If not please inform the Management Team with justification* |
| | The dissemination level corresponds to that indicated in the DOW | | |
| | The contributors (authors) correspond to those indicated in the DOW | | |
| | The Table of Contents has been validated with the Activity Leader | | *Please validate the Table of Content with your Activity Leader before drafting the deliverable* |
| | I am using the AQUAEXCEL2020 deliverable template (title page, styles etc) | | *Available in "Useful Documents" on the collaborative workspace* |
| ***The draft is ready*** | | | |
| AFTER | I have written a good summary at the beginning of the Deliverable | | *A 1-2 pages maximum summary is mandatory (not formal but really informative on the content of the Deliverable)* |
| | The deliverable has been reviewed by all contributors (authors) | | *Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.* |
| | I have done a spell check and had the English verified | | |
| | I have sent the final version to the WP Leader, to the 2nd Reviewer and to the Project coordinator (cc to the project manager) for approval | | *Send the final draft to your WP Leader, the 2nd Reviewer and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewers of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.* |