Chimica Organica Industriale

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General information and teaching material

-Lectures will be recorded upon request

->1 Seminar(s) by an industrialist

-Teaching material (slides and related solvent selection guides, reagents selection guides, etc. useful links, previous exams, etc. available on Virtuale).

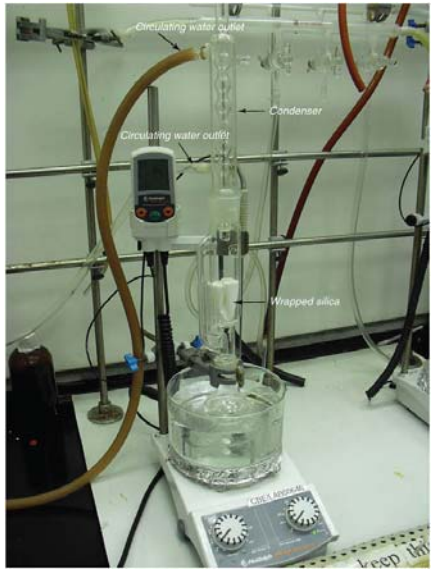
-Textbook to look up: N. G. Anderson, *Practical Process Research & Development* 2nd ed., **2012**, Academic Press

(available on Virtuale or via the library service)

http://www.sciencedirect.com/science/book/9780123865373

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

From mg to tons

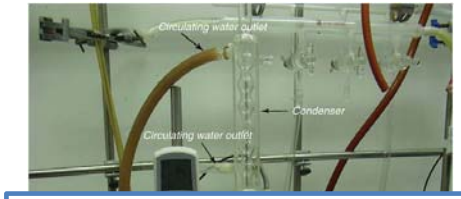


http://www.nature.com/nprot/journal/v6/n7/images_article/nprot.2011.340-F3.jpg

http://randyo.squarespace.com/storage/pilot%20plant%203.jpg?__SQUARESPACE_CACHEVERSION=1251397329041

https://www.solvias.com/img/news/Kilo-lab.jpg

From mg to tons



Aim of the course:

-enrich your theoretical organic chemistry knowledge (new reactions, multi-step synthesis, polyfunctional substrates, mechanisms)

-scale-up of a reaction/synthesis for producing a fine chemical

http://www

https://www.solvias.com/img/news/Kilo-lab.jpg

Background knowledge

Basic (organic chemistry I + II):

-reactivity, reagents and functional groups in organic chemistry: e.g. nitration of aromatics, sodium borohydride, what is an amine?

-structure and stereochemistry: what is the π-system of an olefin? what are two enantiomers?

-what is catalysis?

-**experimental**: work up, evaporation, crystallization, distillation, etc..

Less basic (organic chemistry II + III):

-protecting groups

-[peptide coupling]

-[multi-step organic synthesis]

-metal catalyzed cross-coupling

-asymmetric synthesis

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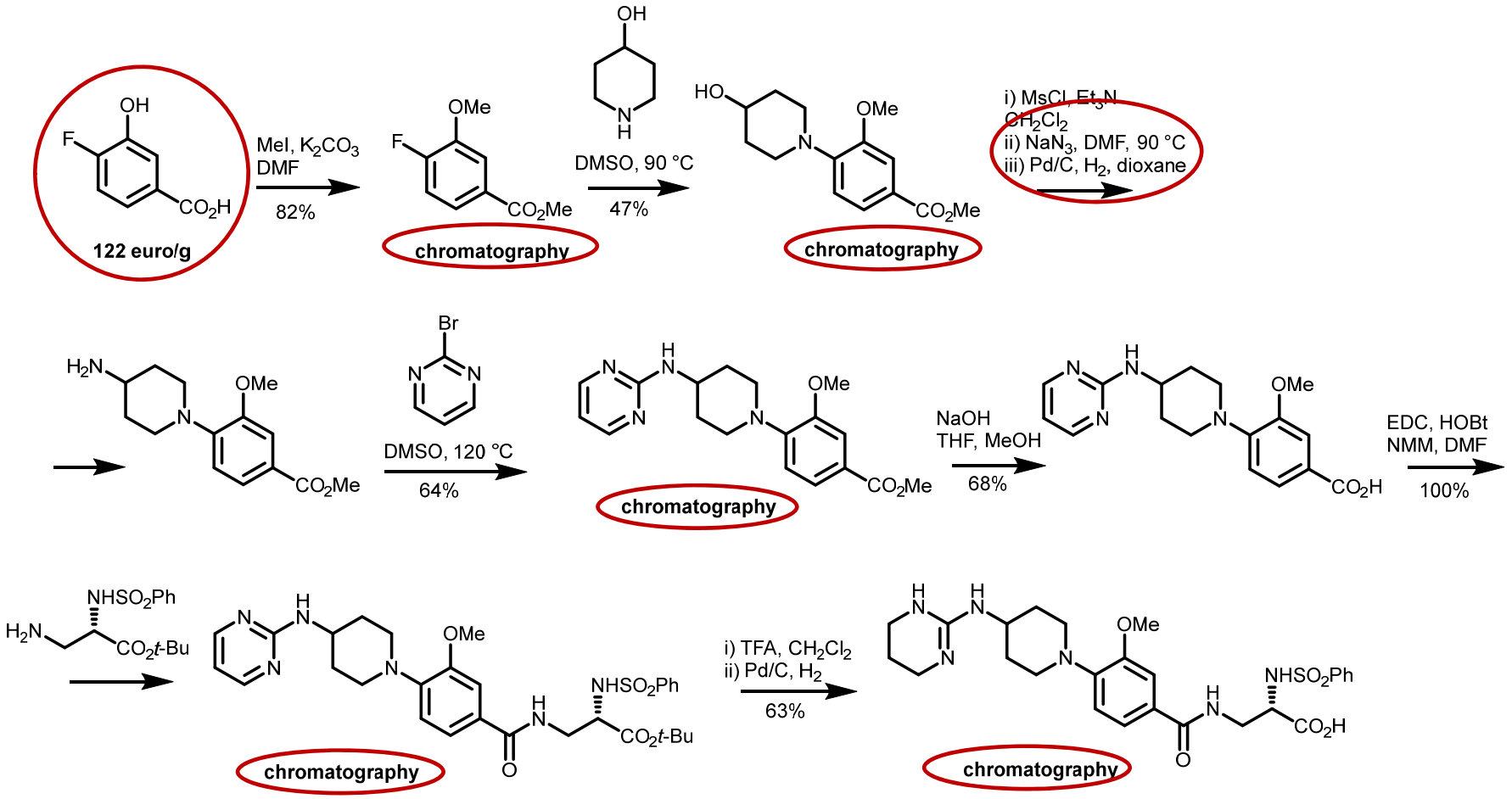
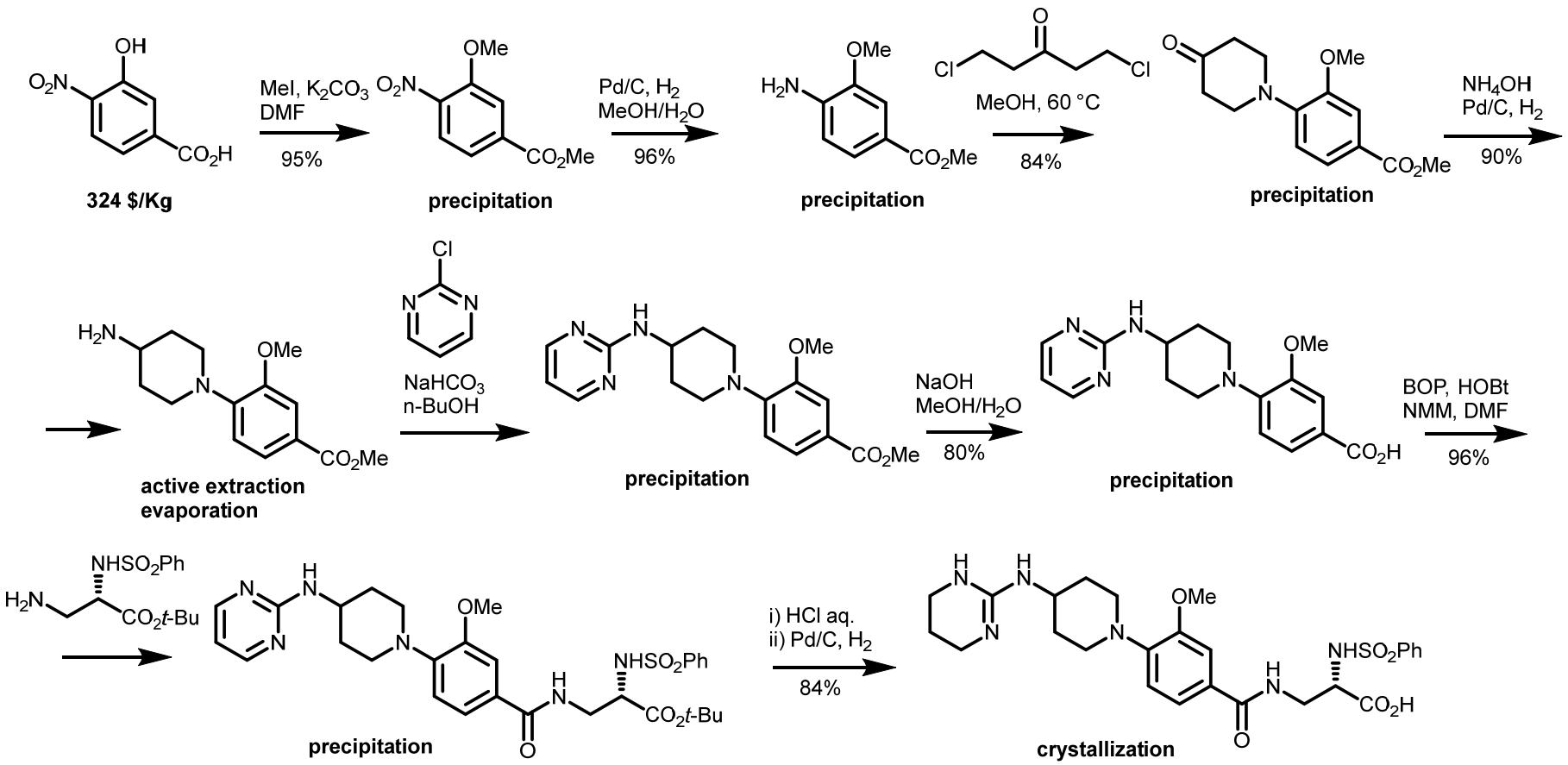
Disclosure (mg-scale) synthetic route – NOT suitable for scale up



Process chemistry (Kg to tonn) route – suitable for scale up



Route Selection

=

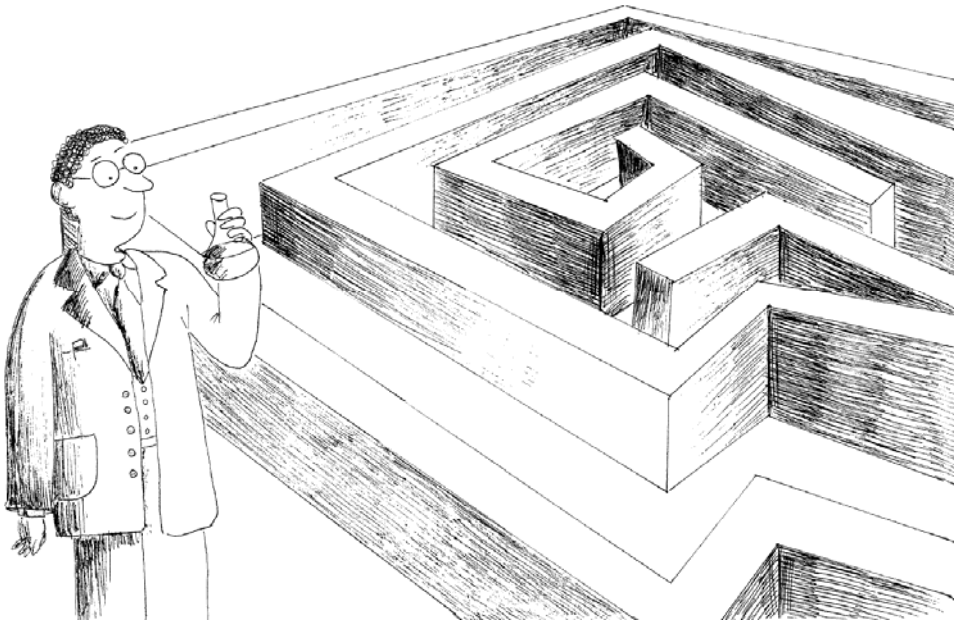
Efficient organic synthesis
-Yield
-Selectivity
-Convergency
-Step economy
-Redox economy

+

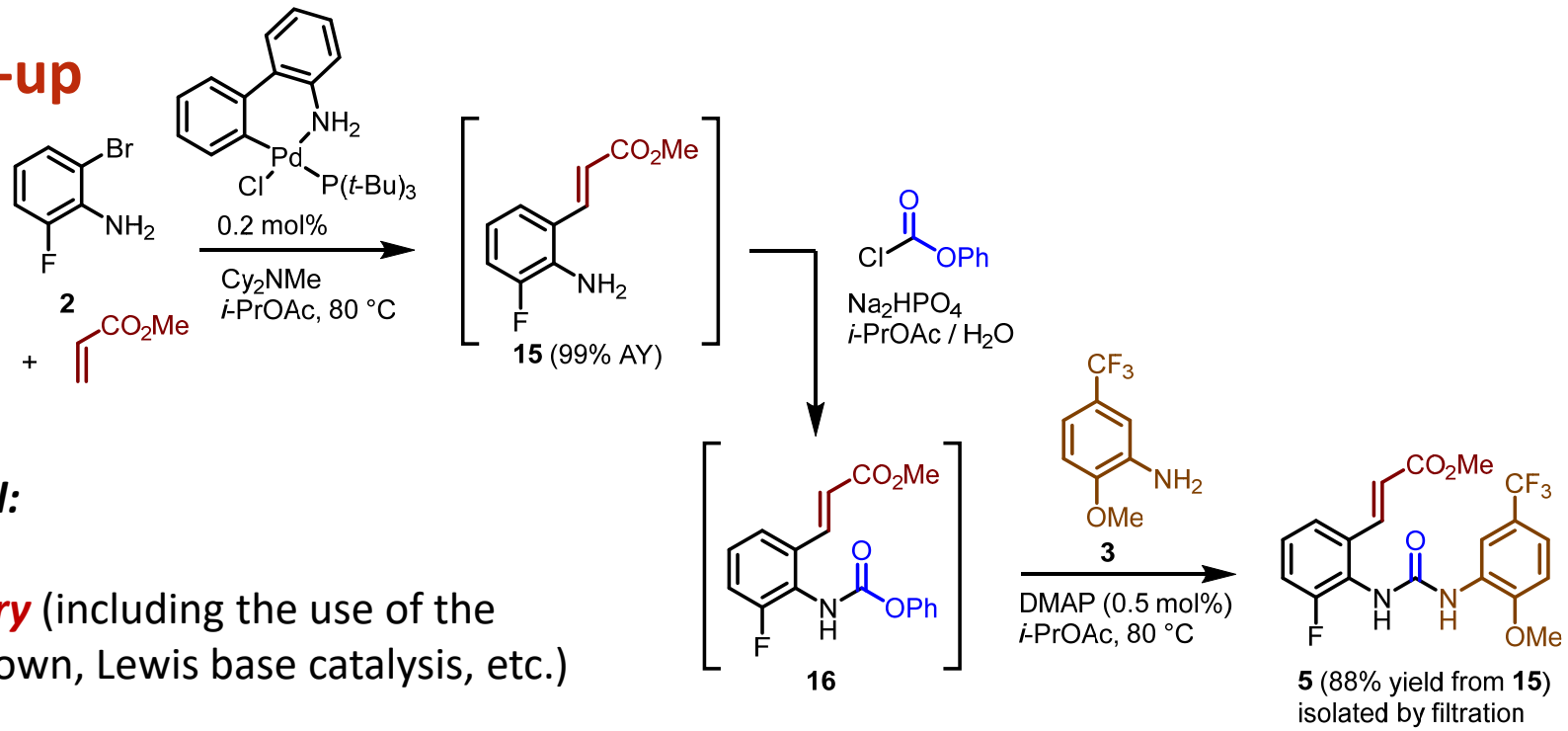
The **SELECT** acronym
*-**S**afety*
*-**E**nvironment*
*-**L**egal*
*-**E**conomics*
*-**C**ontrol*
*-**T**hroughput*

+

Soft factors
-robustness
-availability of SM
….



A successful scale-up sequence



During the course we will:

-***Understand the chemistry*** (including the use of the palladium pre-catalyst shown, Lewis base catalysis, etc.)

-Appreciate why the sequence is ***suitable for scale up***:

- -Telescoped steps (no isolation of intermediates).
- -Direct isolation of the product from reaction stream by filtration.
- -Biphasic Schotten-Baumann conditions for the acylation.
- -Single solvent for the three steps (easy to recycle).
- -*i*-PrOAc solvent: favourable H&S and environmental.
- -low PMI.

Case studies and exam

Case studies will be taken to illustrate the process development of organic, complex molecules.

Written exam based on a literature article describing the scale up process of a molecule. The exam will deal with:
-analysis of costs and environmental impact (metrics)
-questions on the organic chemistry
-questions on the different concepts/strategies related to the scale up of the synthesis.

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