Guidelines for reporting in an MSc and BSc thesis

This document should give students an indication of what is expected from them upon reporting their research work for the BSc or MSc degree. Note that the guidelines will be applied slightly less strictly for BSc theses than for MSc theses, but everybody should try to adhere to these as a good exercise.

Guidelines are given regarding the contents of the thesis, numbers, use of variables, units, the role of figures, their lay-out and legends to figures and tables, literature list, appendices.

Begin with the report directly from the start of your project. Using the given outline and your thesis proposal you can, already at an early stage, write certain parts of the thesis (e.g. intro, objectives).
Do that, it saves you precious time at the end by taking away lots of administrative load.

General - goal

The goal of the report is to present your work in a clear and concise way, but complete and with sufficient detail in order for a new student to be able to repeat the work based on the report.

The main part of the report (*i.e.,* from introduction to recommendations) should not be more than 30-40 pages.
The challenge is to keep main aspects separated from side issues, to keep a clear main storyline.

Details of experimental and computational procedures, and full experimental results, should be given in Appendices. Depending on the data load these can be provided digitally, when graphical presentation suffices.

Whenever you use parts of articles or figures refer to these source(s). Put literal quotations of texts between quotation marks, and refer to the source. Reports will be checked for plagiarism (see references). Of course you can check it yourself as well through Blackboard.

Report structure *(see references for formatted examples)*

- Outside cover
  - Use a nice graph or image if you like
  - Title of thesis, full name, student #, date of presentation/defense
  - Logo TUDelft and section/department
- Inside title page
  - Use the page provided by the university
  - Title of thesis, full name, student #,
  - Period of MSc / BSc work; Date of presentation/defense
  - Supervisor(s)
  - Thesis committee
  - Logo TUDelft and section/department

    - The report should be treated as confidential
    - Reports should **not** be sent to the repository of the TUDelft. Our research is part of the PhD work, often under contract, and not to be released before approval of supervisors or funding organization. Limited distribution for formal reasons is done by our secretariat.
- Abstract
- Contents
- List of Figures, List of Tables are optional
- Notation (units)
- List of used abbreviations/acronyms
- Introduction
    - Introduction into the topic, providing a background/motivation for the research
    - Description of the objectives/goal of your project and the approach plan (*we are fond of original approaches*)
- Theory / Literature
    - Depending on the topic that is going to be presented:
        - State of the art can be given by a literature review (*don't hesitate to find more literature than your supervisor gave*)
        - A theoretical basis for the work that has been done
        - or both
- Experimental
    - Overview of the experimental approach, procedures, experimental set-ups and techniques used, experiments, analyses, definitions, sample codes. Move too much detail to the Appendices.
      Indicate for what purpose you used each technique.
    - Description of computer codes used, flow schemes, theoretical basis of the techniques used, etc.
      Whatever technique you use, grasp the background or theory behind it and understand how it works. It helps you appreciate the significance of the results. Don't accept uncritically the output of an instrument.
- Results
    - Present results in a logical way, e.g.
        - Synthesis
        - Characterization
        - Performance (error analysis !)
    - This is not necessarily the chronological way, although briefly reasons for changing approaches can be given.
    - In case of large amounts of results, select the most important ones in this part, and provide an overview of the whole result set. Details should be presented in the Appendices.
    - Failures are to be reported, preferably also causes if known. This prevents that others face similar issues.
    - Remember you are engineers, fond of quantitative analysis.
    - Avoid starting the overall discussion of the results, although specific (separate) aspects may be dealt with here.
      A logical presentation and combination of results paves the way for a clear discussion.

- Discussion
    - Discuss the results in the light of the research objectives, the existing literature and try to arrive at nice conclusions/logical relations/trends in the data, maybe set-up new theories.
    - The separation of Results and Discussion should facilitate the discussion from a broader perspective and be more concise.
      A combined treatment often results in an incremental treatment and repetitions every time a new result is presented and discussed. Now all results are already known and can be used in a discussion.
      However, the split does not have to be strict: you can discuss individual results while presenting them, followed by an overall discussion once all results have been given to the reader.
    - Don't forget to include literature in your discussion, essential to be able to indicate what the novelty/status of your work is.
    - One can start with some general remarks/observations after which more detailed discussions on different aspects are developed. Take care that you mention the important conclusions already in this part.
- Conclusions
    - Summarize the important conclusions of your work (*also if certain goals have not been achieved, you are not evaluated on successes but on performing and reporting research*).
    - Keep your conclusions concise. This chapter should not contain new information or discussion.
- Recommendations
    - What can be done in order to make a next step in the research, to eliminate loose ends, or to depict other interesting applications of (certain parts) of the work. Justify your recommendations, and go beyond the obvious statement that “more research should be done”.
- Literature (see later)
- Acknowledgements
    - Probably several people assisted you during the work, especially experimentally (technicians, fellow students).
- Appendices
    - Each appendix 1, 2, 3,.. or A, B, C.. should also bear a title.
    - Give a clear description in the appendix of what is presented, not just tables and figures without any other information. It should be as readable as the report.
    - Include the project outline as agreed at the start. (The literature review can be included in the introduction and can be omitted here)

General remarks regarding the contents

- Use page, chapter, and paragraph numbers
- Use SI units, their derived units or accepted alternatives (see refs)
    - Never use the units in plural (e.g. mins, hs)
    - Use official prefixes (e.g. don't mix k with K)
    - If other units are to be used these should be clearly defined
    - For litre use the capital L, to avoid confusion with 1.

    - Units are not abbreviations, don't use a period behind them.
- Numbers
    - Use period (.) as decimal point (unlike many European countries)
      3.14

      You may have to change your Windows settings for Excel use.
    - Don't use comma (,) to indicate thousands, but a (nonbreaking) space instead, or of course power representation: 50 000 or $5*10^4$
    - Think about how many significant digits you use.
    - Use a non-breaking space between value and unit: 25 kg
- Variables and parameters are to be presented in *italics* and their dimensions in normal font

  s [m] = s_0 [m] + $v \cdot t$ [(m s^{-1}) s] + 0.5 $a \cdot t^2$ [(m s^{-2}) s^2]
- Equations/formulas are made most easily with Mathtype (available as university software)

  $s = s_0 + v \cdot t + \frac{1}{2} a \cdot t^2$
- Error analysis
    - You should estimate the uncertainty in all reported measurements (e.g. the mass m is 3.04 g with an uncertainty of 0.02 g).
    - Where needed, apply error propagation. For example: you measure the density ρ of an object by measuring its mass m and volume V. As you calculate the density according to $\rho = m/V$ and do not measure it directly, you need to understand how the uncertainties in the mass and volume measurements translate into an uncertainty in the density.
- Literature is cited most easily and reference list updated by using software like Endnote, Reference Manager, Pages or similar
    - Train yourself in using such a programme from the beginning of your project.
    - Citation in the text:
        - With numbers between square brackets [ref#] avoids confusion with superscripts. Reference list should be in order of citing.
        - Alternatively citation can be by (author, year)
          In the latter case the reference list is in alphabetical order of the last name of the first author. This has the advantage that a reader familiar with the field directly sees which paper you refer to.
- Reference list
    - In order of citation or alphabetically (see above)
    - Provide:
        - All authors
        - Title of paper
        - Journal, volume, year, pages
        - Or for a Book: eds (if applicable), publisher, year, pages (if applicable)
- Legends to the Figures and Tables
    - Should be self-explanatory
    - Should describe what is presented, with sufficient details about conditions

Figures

As a special case the figures in the report are dealt with, also relevant for presentations. This is all about comprehensibility, uniformity and clarity.

- Use 'sans serif' fonts in the figures (Arial, Tahoma, Helvetica, Calibri, ...), to have a clear distinction from the main text and better readability.
- Axes and scaling should be easy to read. E.g.
    - 0, 1, 2, 3, ...
    - 0, 10, 20, 30, ...
    - 0, 50, 100, 150, 200, ...
    - Not: -1, 2, 5, 8, 11, ... etc.
- Keep values within reasonable ranges, as above
    - Either adjust the used unit with prefixes or express the scale in the dimensions (see below)
- Provide sufficient 'tic-marks' for readers to read off /estimate values of data points
- The values at the axes represent dimensionless numbers. The *x*- and *y*-axis legends, should therefore also represent a dimensionless quantity, a variable divided by its dimension:

  $t\,/\,\mathrm{s}$ $\quad T\,/\,\mathrm{K}$ $\quad 10^3 T^{-1}\,/\,\mathrm{K}^{-1}$

  $N_i\,/\,10^{-6}\,\mathrm{mol\,s^{-1}\,m^{-2}}$ or $N_i\,/\,\mu\mathrm{mol\,s^{-1}\,m^{-2}}$
- The above excludes any ambiguity about the interpretation and absolute value of the variables that are plotted. Often one can find something like $\times 10^3$ plotted near an axis, but it is not clear whether the values should be multiplied or have been multiplied by this number. Avoid this also in tables.
- Use the largest font size for the axes legends, and a smaller one for the numbers. They should be properly proportioned to the graph itself.
- Text can be put in the graph to indicate conditions belonging to a curve or bar. This saves text in the legend to the figure.
- Use the same symbols and colours throughout your report consistently for the same systems, this makes reading and interpretation a lot easier.
- Note that in BW printing colours are lost and use of symbols or text in graphs may alleviate that.
- Standard Excel graphs should be avoided, they can be improved a lot for textual incorporation, but never use them in presentations without sufficient polishing (especially remove the symbol legend labels panel)

Some examples of proper figures, table and legends
(PhD Thesis J. van den Bergh, TUDelft, 2010)

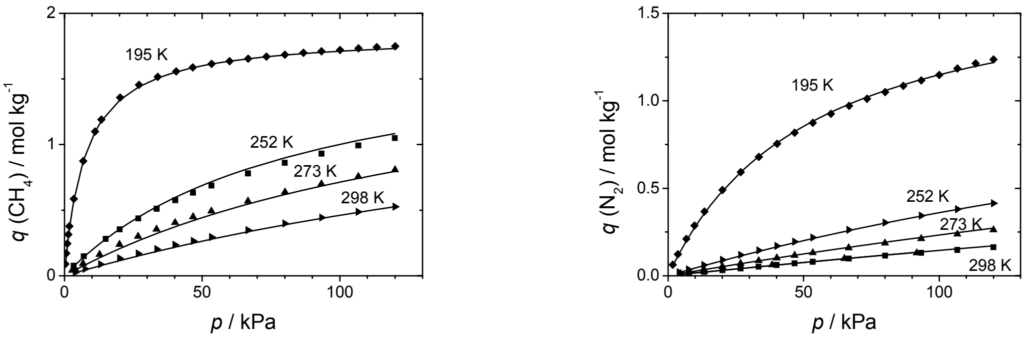

Figure 1. Adsorption isotherms of carbon dioxide, nitrous oxide methane, nitrogen, argon, krypton, neon and oxygen on DD3R crystals at 195, 252, 273 and 298 K. Lines represent results of a full data fit with a single- or dual-site Langmuir model (Equation 1).

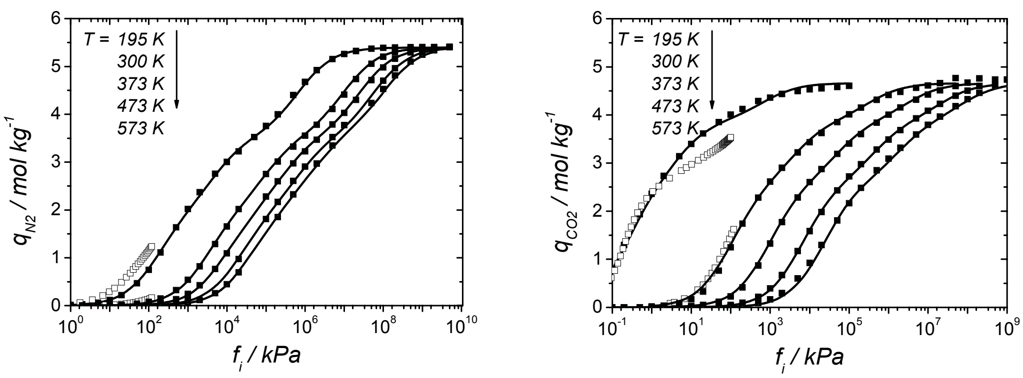

Figure 1. Adsorption isotherms of N_2 and CO_2 on DDR at 195, 300, 373, 473 and 573 K. Closed symbols represent GCMC simulated data, lines represent model fit results with a three-site Langmuir model and the open symbols represent experimental adsorption data on DD3R at 195 and 298 K respectively [12].

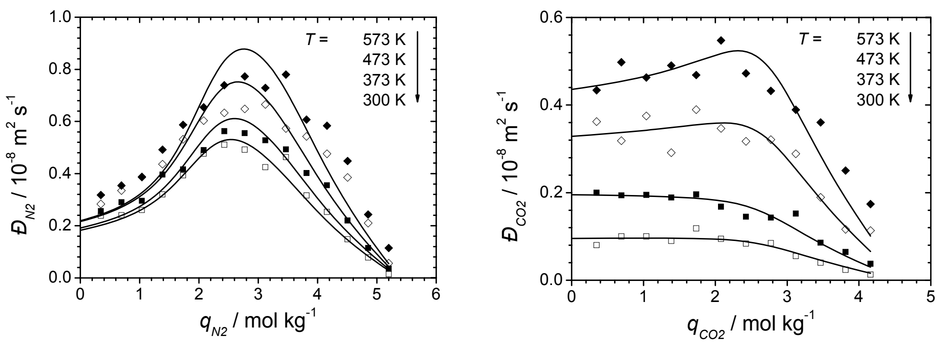

Figure 2. Maxwell-Stefan diffusivities of N_2 (left) and CO_2 (right) on DDR at 300, 373, 473 and 573 K. Lines represent model fit results with the RSM (Equation (1)).

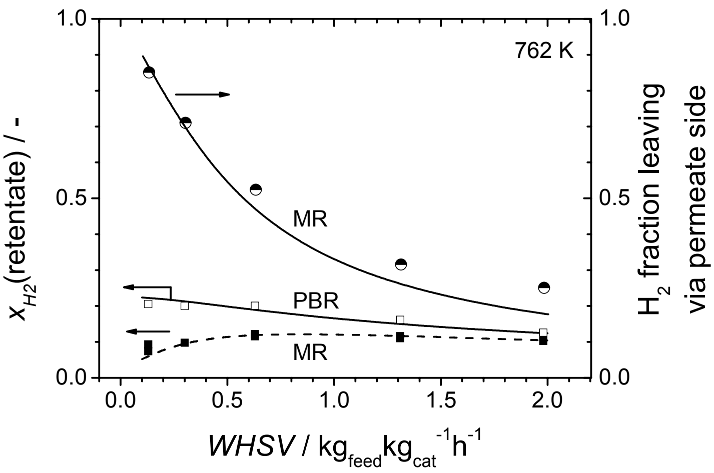

Figure 6. Fraction of H_2 in the retentate of the PBR and MR at 762 K as a function of the *WHSV*. Points are experimental data, lines are modelling results.

Table 1. Single-site Langmuir adsorption parameters of CO_2, CO and H_2 on DD3R crystals. Including the adsorption enthalpies of N_2, Ar, Kr and CH_4 determined previously [7](Chapter 2) and the adsorption enthalpies of a series of light gases on silicalite-1 (MFI) [24].

	q (100 kPa, 298 K) mol kg^{-1}	q^{sat} mol kg^{-1}	K_0 kPa^{-1}	ΔH_{ads} kJ mol^{-1}	ΔH_{ads} (MFI)^{b} kJ mol^{-1}
CO_2	1.47	3.46	$5.26\cdot10^{-7}$	-23.7	-24.0
CO	0.19	1.89	$2.58\cdot10^{-6}$	-14.9	-17.9 ^{c}
H_2	0.10 (253 K)	3.66	$8.22\cdot10^{-6}$	- 5.6	- 5.9
O_2	0.13	-	-	-14.6 ^{a}	-
N_2	0.15	1.75 ^{a}	$2.83\cdot10^{-6}$ ^{a}	-14.3 ^{a}	-13.8
Ar	0.13	-	-	-14.5 ^{a}	-13.2
Kr	0.40	-	-	-18.8 ^{a}	-19.3
CH_4	0.45	-	-	-17.3 ^{a}	-22.6

^{a} Data taken from [7]; ^{b} Data taken from [24]; ^{c} Determined from membrane permeation data.

References

SI units
http://en.wikipedia.org/wiki/International_System_of_Units

Citing
https://tulib.tudelft.nl/writing-publishing/how-to-cite/

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