

Deinkability of UV curing printing inks

Beatrix Genest, Carolin Sommerer (SID)

Antje Kersten, Dr. Hans-Joachim Putz (PMV)

Sächsisches Institut für die Druckindustrie GmbH, Leipzig

Papierfabrikation und Mechanische Verfahrenstechnik, Technische Universität Darmstadt

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UV inks in sheet-fed offset printing –
Deinkability and fate of substances of health concern

Targets:

- Objective evaluation of the deinkability of UV printing products
- Effect of printing conditions (ink, paper quality, curing technology)
- Comparison between UV printed and conventional offset printed products with and without UV varnish
- Determination of measures to optimise printing process conditions regarding deinkability
- Evaluation of the impact of increasing proportions of UV printing products on the quality of paper for recycling

Phase 1: Commercial UV prints

38 printed products from different printers

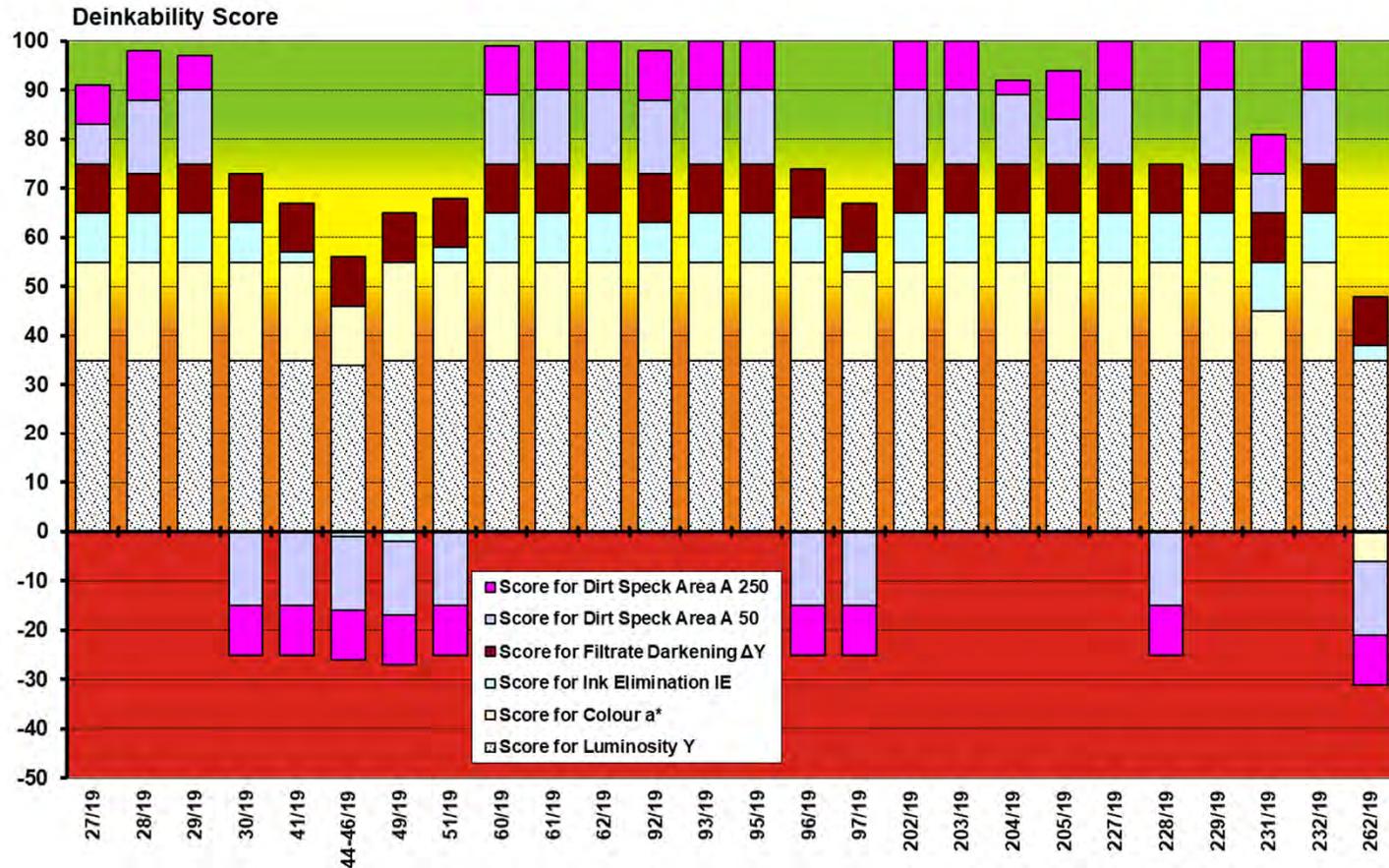
28 print products tested

Deinkability Test:

- 17 passed
- 11 failed

Reason:

- Dirt speck area



Phase 1: Commercial UV prints

Influencing Factors on Deinkability

- No effect of paper quality
- Problems with some samples cured with mercury lamps and some samples cured with iron-doped mercury lamps
- No correlation between hardening degree and Deinkability Score
- Different results for different ink formulations

Phase 2: Pilot Scale Test on Sheet-fed Press

Test Conditions

- Sheet-fed Press SM DC 74-5+L
- UV technologies: mercury lamp, iron-doped mercury lamp, UV LED
- 6 Substrates: coated paper (glossy/matt), uncoated paper
- 16 UV inks, 3 conventional inks
- 3 UV varnishes (in combination with UV ink and conventional ink)
- Variation of UV dosage
- Variation of pressure and composition of dampening solution (with/without IPA)
- At all 180 variations

Phase 2: Pilot Scale Test on Sheet-fed Press

Test Form (single-sided print)

Version 1: (small picture)
 Picture, text, screen tints
 Average ink coverage 40%

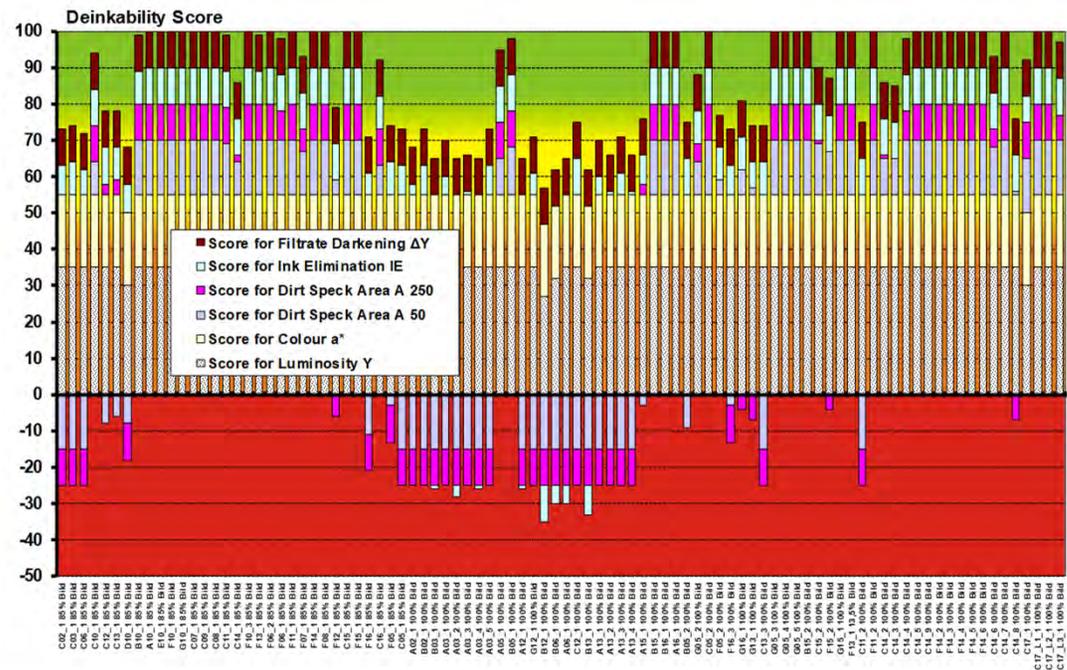
Version 2: (big picture)
 Pictures, screen tints
 Average ink coverage 200%



Phase 2: Pilot Scale Test on Sheet-fed Press

Deinkability Results

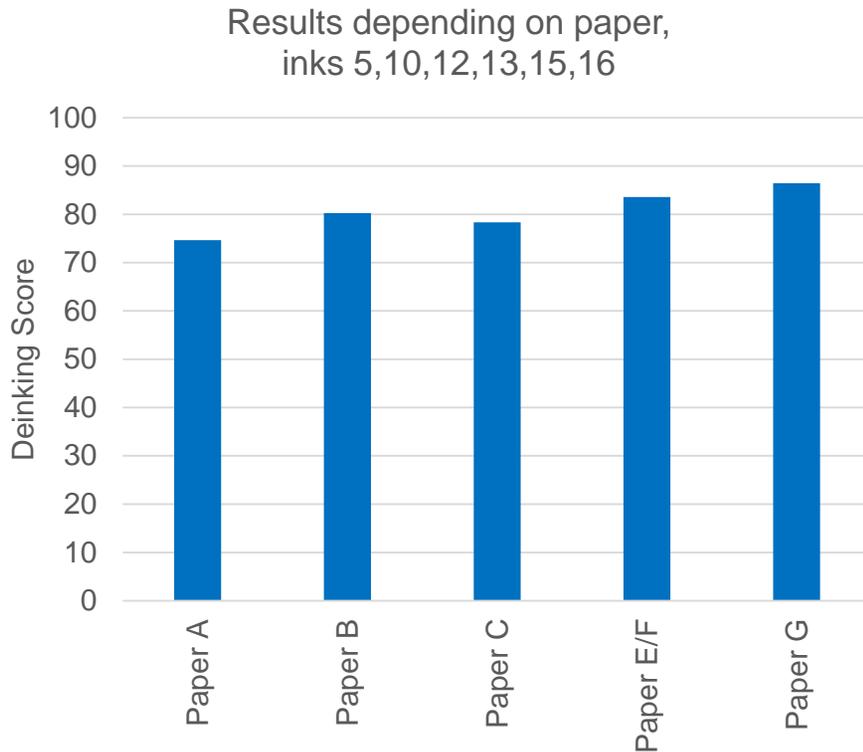
- Test Form version 1: all samples with good deinkability
- Test Form version 2: differentiated results
- ~ 40% not deinkable
- Reason: Dirt speck area



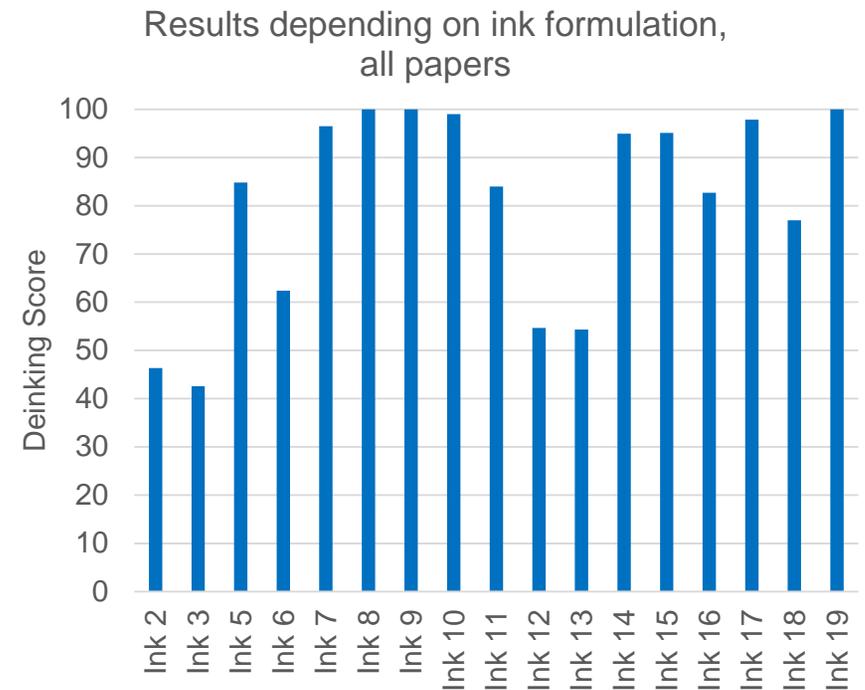
Phase 2: Pilot Scale Test on Sheet-fed Press

Influence on Deinkability Results

– Paper quality:



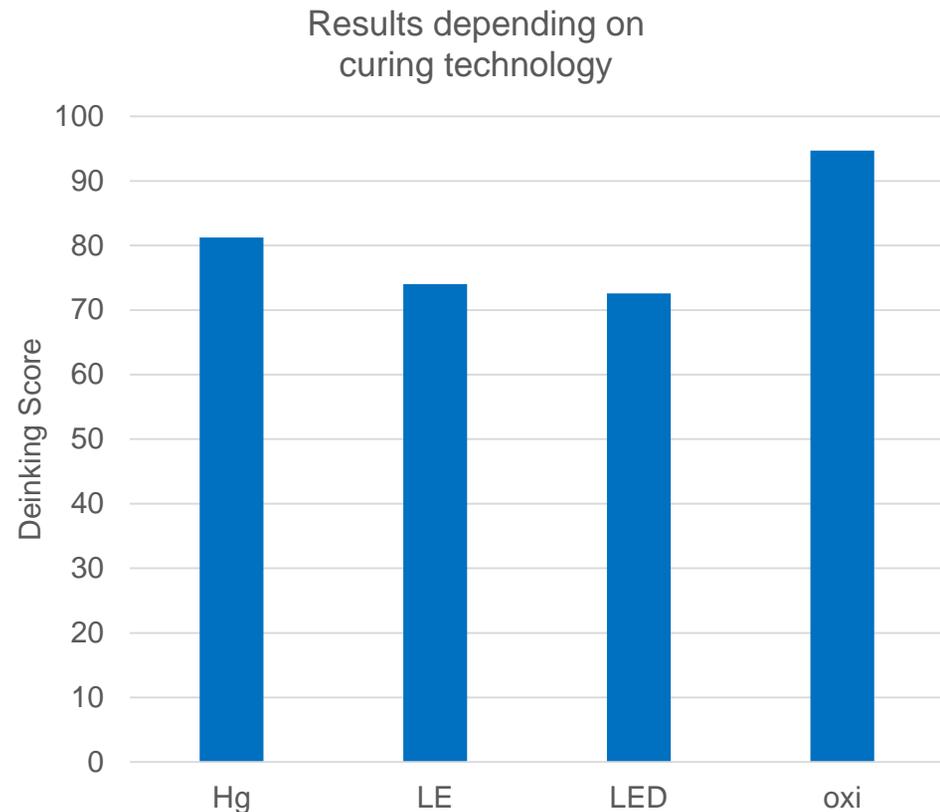
- Ink formulation:



Phase 2: Pilot Scale Test on Sheet-fed Press

Influence on Deinkability Results

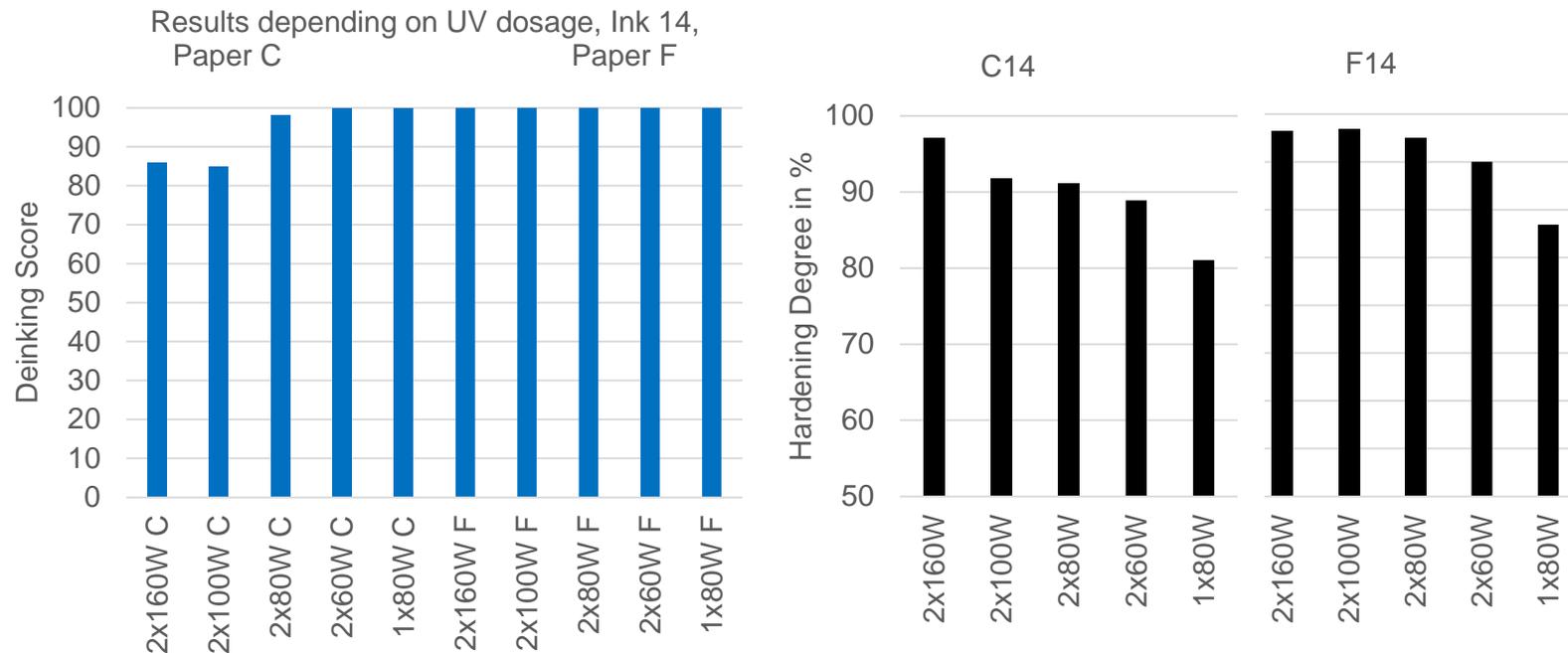
- UV technology:
- Best results with conventional ink
- Only a few tests with LE (iron-doped mercury lamp)
- LED worse results compared to the mercury lamp



Phase 2: Pilot Scale Test on Sheet-fed Press

Influence on Deinkability Results

- UV dosage: (samples with good deinkability)

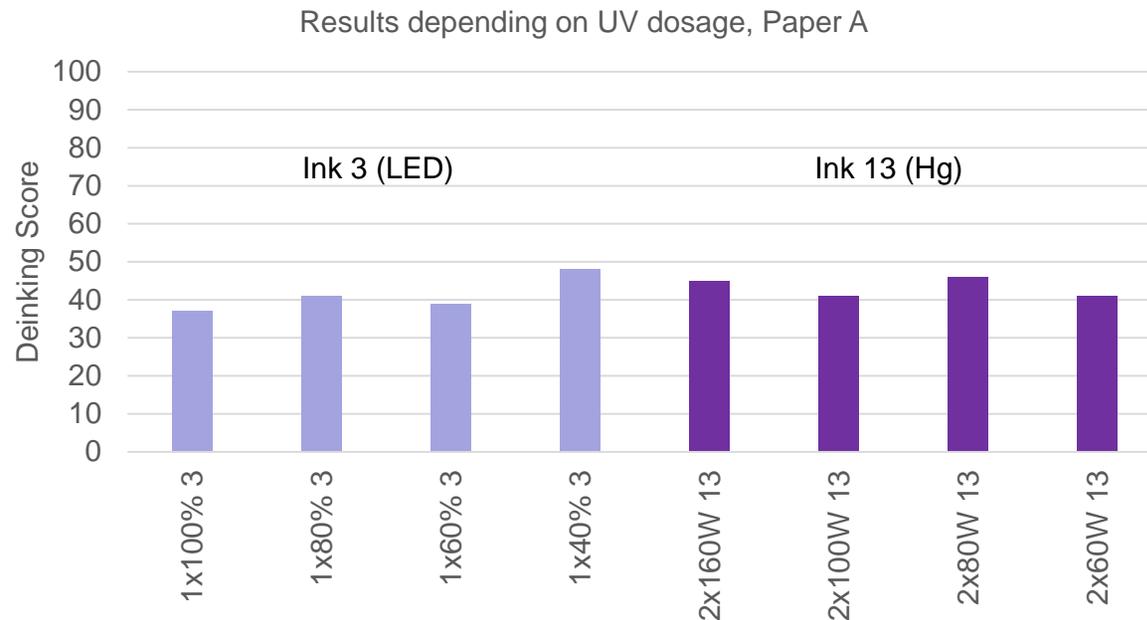


- Hardening degree correlates with UV dosage, but not with deinkability

Phase 2: Pilot Scale Test on Sheet-fed Press

Influence on Deinkability Results

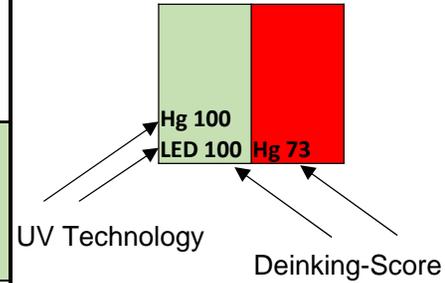
- UV dosage: (samples with bad deinkability)



- No correlation between hardening degree and deinkability

Phase 2: Pilot Scale Test on Sheet-fed Press

| Ink | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|----------------|---|-------|-----------------------------------|--|-----------------|--------|--------|-------------------|--|-----------------|-------------------------|------------------------|---|---------------------------|----------------|---|---------|--|
| Coated Paper | A | Hg 43 | Hg 45 LED 37 Dosis 39-48 | Hg 95 | Hg 35 | | | Hg 100 | | Hg 39 | Hg 41 Dosis 41-46 | | Hg 73 | Hg 100 | | | | |
| | B | Hg 48 | Hg 39 | Hg 98 LED 66 | Hg 32 | | | Hg 99 | Hg 93 Hg 99 Hg+L1 50 LED 77 LED 54 | Hg 40 | Hg 29 | Hg 100 IPA Hg 97 | Hg 100 IPA Hg 100 | Hg 100 IPA Hg 100 | oxi 96 | oxi 100 Hg+L1 69 | oxi 100 | |
| | C | LE 48 | LED 49 | Hg 100 LED 48 | Hg 47 | Hg 100 | Hg 100 | Hg 100 | Hg 94 | Hg 99 LED 50 | Hg 50 Hg 70 | Hg 49 Hg 72 | Dosis 86-100 Pressg 93-100 Hg 85, 86 IPA Hg 69 | Hg 100 Hg 100 | Hg 92 | IPA oxi 92 L1, L2, L3 Hg 97-100 | | |
| Uncoated Paper | E | | | | | | | Hg 100 | Hg 89 LED 86 IPA: Hg 95 LED 100 | | | IPA Hg 100 | | oxi 100 IPA oxi 100 | oxi 62 | | | |
| | F | | | Hg 77 LED 61 | Hg 98 LE 100 | Hg 93 | Hg 100 | Hg 100 LED 100 | Hg 100 LED 100 | Hg 73 | Hg 99 Hg 100 | | Hg 100 Hg 100 Dosis 100 | Hg 83 Hg 100 | Hg 50 Hg 60 | | | |
| | G | | | Hg 100 Dosis 100 LED 88 LED 100 | | | | Hg 100 | | | Hg 46 | Hg 67 | | Hg 100 | Hg 77 | | | |



Explanation:

Bad deinkability

Deinking, Score < 90

Good deinkability

Different results

Phase 2: Pilot Scale Test on Sheet-fed Press

Impact on Deinkability Results

– Summary

| Parameter | Effect |
|------------------------------|--------|
| Ink formulation | ++ |
| Paper quality | o |
| Coated/uncoated paper | + |
| UV dosage, hardening degree | o |
| UV technology | + |
| Ink coverage | ++ |
| Pressure, dampening solution | o |
| UV varnish | + |

Conclusions

- Main influencing factors are ink formulation and ink coverage
- UV dosage/energy consumption induced by requirements of printing process
- UV varnishes can influence the deinkability (both UV inks and conventional inks)
- For general evaluation of deinkability a test form with defined ink coverage and paper quality has to be determined

Thank you for your attention!

Sächsisches Institut für die Druckindustrie GmbH

MommSENstraße 2, 04329 Leipzig

Telefon: +49(0) 3 41/2 59 42-0

Telefax: +49(0) 3 41/2 59 42-99

E-Mail: info@sidleipzig.de

Internet: www.sidleipzig.de